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A. PRESCOTT FOLWELL, Editor

W. A. HARDENBERGH, Asso. Editor

Timewasters

John Bevan continues with some timely contributions of a slightly new nature to this column of calculations, to wit and as follows:

Preparedness:

Three reserve officers were participating in a target match. Capt. Jones normally hits the target 4 times out of 5; Lt. Smith 3 times out of 4; and Capt. Brown 2 times out of 3. If they fire together and find 2 hits in the target, what is the chance that one of the hits was made by Capt. Jones?

Catch-as-catch-can:

Burroughs tells Anderson the result of a football game between Yale and Princeton. Anderson, who speaks the truth 10 times out of 11, says that Burroughs told him that Princeton had won the game. If tie scores are impossible and experience has shown that 75 per cent of Burroughs' statements are correct, what is the possibility that Princeton won the game, assuming that the teams were evenly matched?

Diphantos:

Via the Highway Magazine from D. R. Warren of the Calf. Div. of Highways comes the following: Diophantos passed one-sixth of his life in childhood, one-twelfth in youth, one-seventh more as a bachelor; five years after his marriage a son was born who dies four years before his father at half of his father's age. How old was Dio when he died?

Solutions from August:

The plutocrat who couldn't change any money had a $10 bill, four $1 bills, a dime, a nickel and 4 pennies, says C. N. Easton and several others. The two motorists drove at 43 and 35 mph., and met first at 8 AM. 35 miles from Podunk Center.

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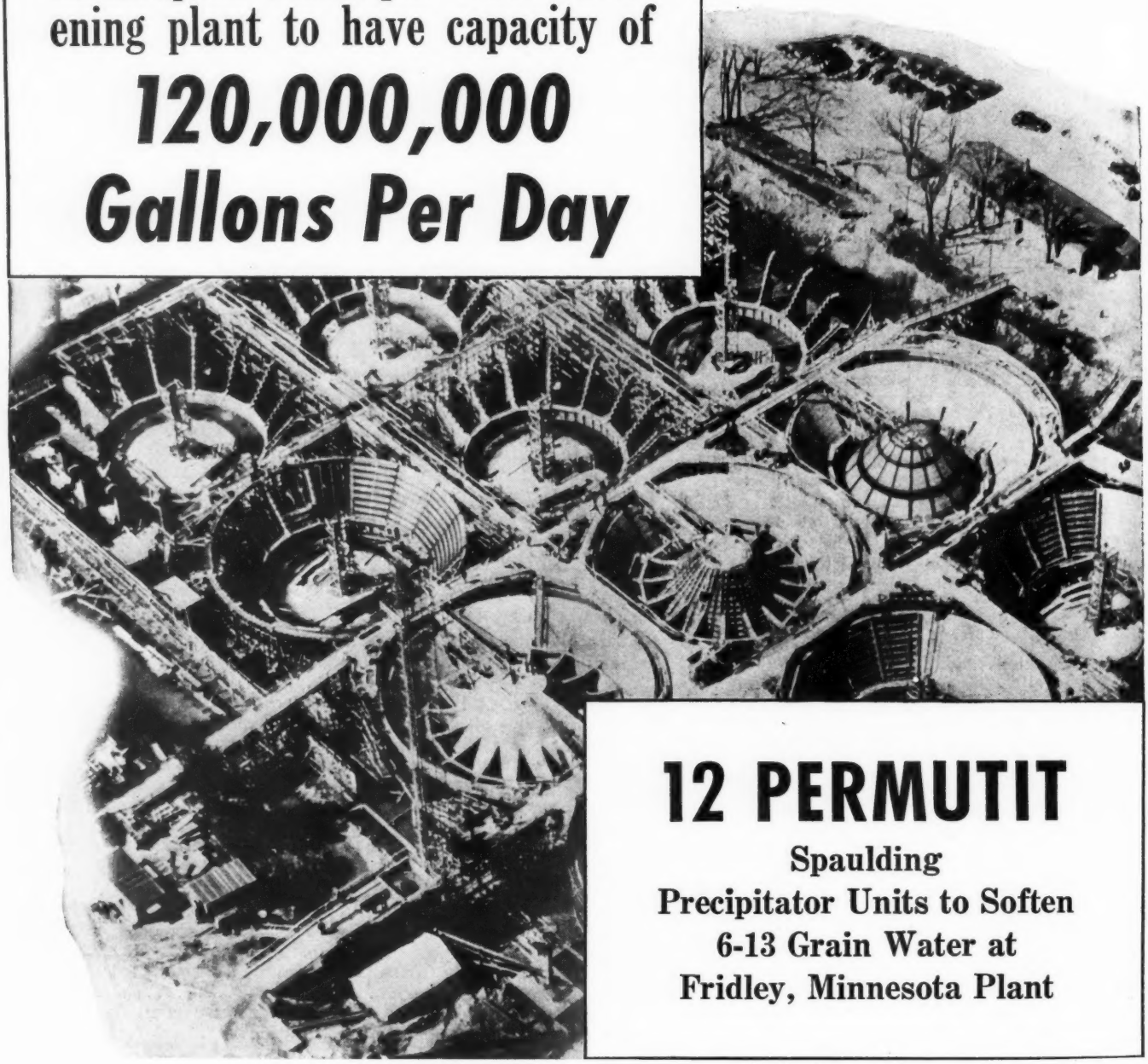

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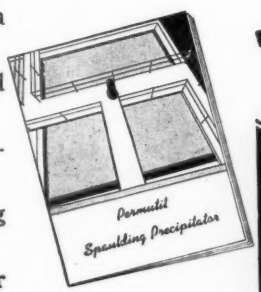

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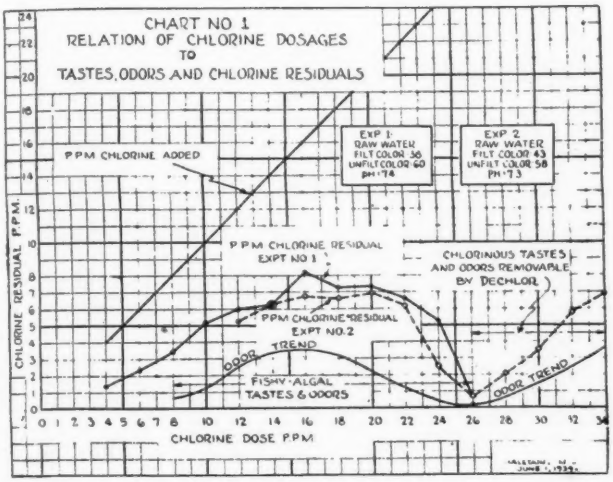
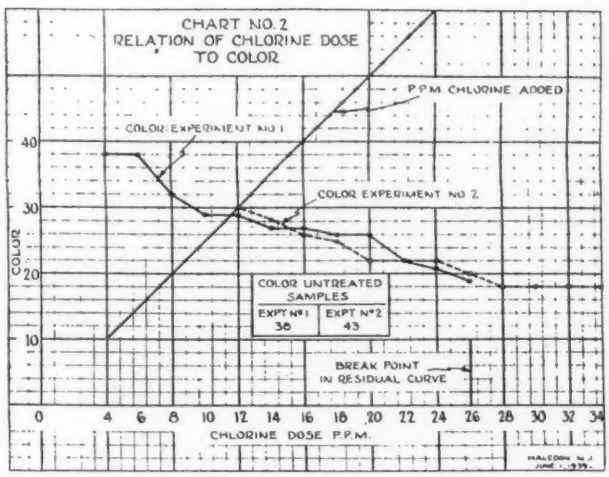




Curves of relations of chlorine dosages to taste, odor, color and chlorine residuals.

Break-point Chlorination

By A. E. GRIFFIN

Technical Service Engineer, Wallace & Tiernan Co.

THE main aims in the purification of water are to render it safe for human consumption and to make it esthetically acceptable to the consuming public. The first objective is attained through the elimination of those bacteria in water that cause typhoid fever or intestinal disorders; the latter objective is gained by the removal of matter objectionable to the senses, such as suspended material, color, tastes and odors.

Chlorine has long played an important part in the processes involved in the fulfillment of these objectives. With the advent of "break-point" chlorination, it will become even more prominent due to the step-up in efficiencies made possible through the use of this process. Break-point chlorination is a process wherein chlorine is added to water under controlled conditions until the chlorine demand of the water is completely satisfied. When this point is reached, further additions of chlorine will result in a residual rise almost in proportion to the rate of application. The point just ahead of this rapid rise in residual is known as the break-point; hence, the name "break-point" chlorination. It is at, or just beyond, this point that tastes and odors disappear. The residuals ahead of this point in waters containing appreciable amounts of free ammonia, (0.05 p.p.m. or more) are usually greater than at the break-point. Waters devoid of ammonia will seldom, if ever, produce a dip in the residual curve at the break-point. In practice, the ratio of chlorine to NH_3 necessary to reach the break-point appears to be somewhere in the neighborhood of 10 to 1.

It has long been known that heavy chlorination, followed by dechlorination, is an effective method of removing odors from water. The process has, however, been wasteful of both chlorine and dechlorinating agents, due in large part to insufficient knowledge as to the action of chlorine on the odor compounds present. Utilization of break-point chlorination, however, now makes it possible to chlorinate to precisely the right point to eliminate more bacteria than has formerly been possible and, at the same time, to produce a water of acceptable quality as regards taste and odor characteristics. To attain this end the increase in chlorine consumption in many cases will be only a few tenths of a part per million greater than under conditions of marginal chlorination, although in some instances it may be necessary to apply several times the usual amount. In either event, the amounts of chlorine involved are usually within the limits of practicability, particularly when the advantages gained are taken into account.

This process of chlorination, to a certain extent, supplants the older process known as "super-chlorination." At the present time, super-chlorination, indicates the addition of chlorine much in excess of the amount needed to reach the break-point. With break-point chlorination, residuals greater than those usually carried under conditions of marginal chlorination may often be maintained without the necessity of using anti-chlorination.

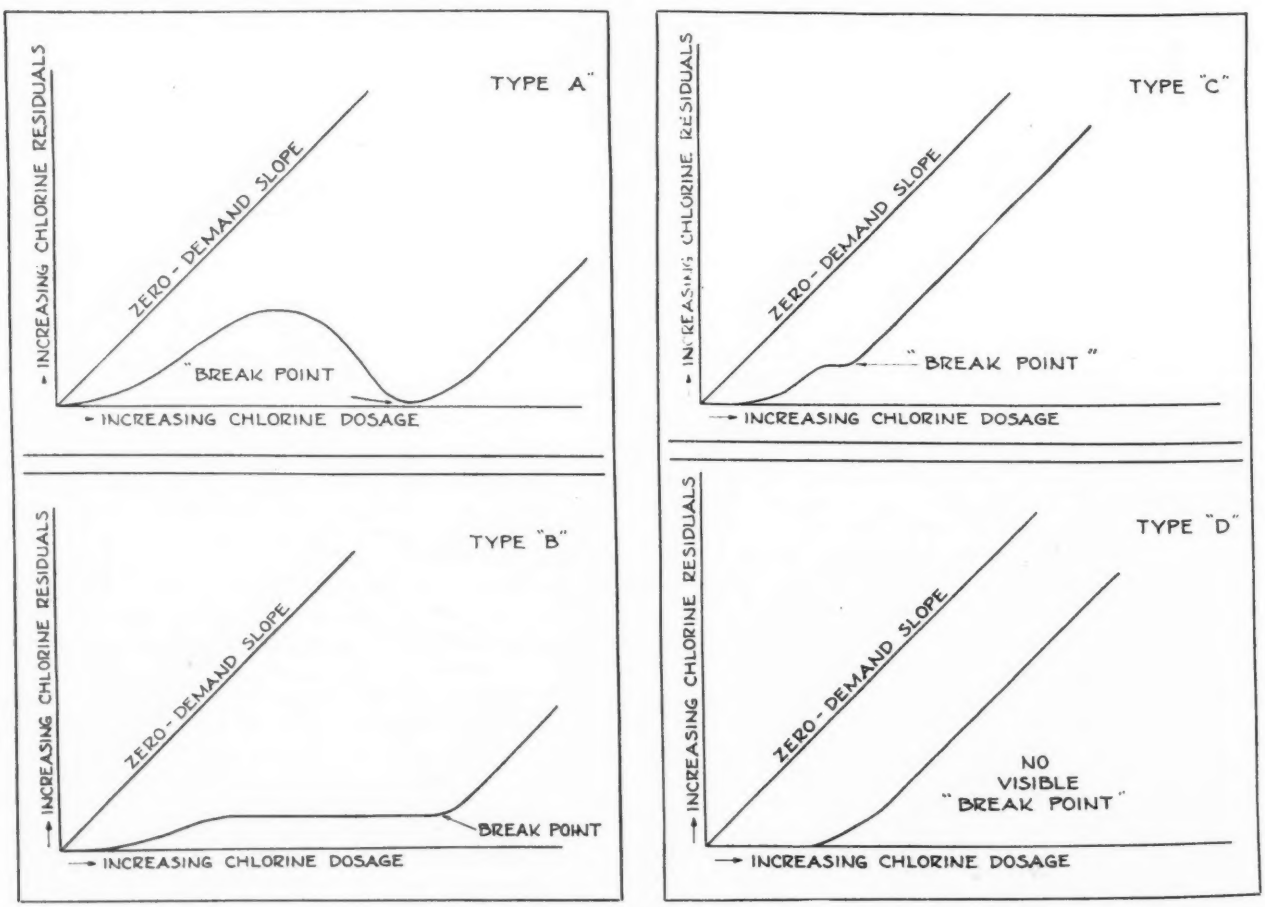
Control of the process in practice is somewhat more

precise than the control of simple or marginal chlorination. Control in the latter case is usually obtained by making frequent chlorine residual tests augmented by bacteriological analyses. In break-point chlorination reliance is also placed upon the familiar ortho-tolidin test except that special emphasis is placed upon the speed of production of the characteristic yellow color. When, upon the addition of ortho-tolidine, yellow color instantly develops and quickly reaches its full strength, sufficient chlorine has been added to reach, or even to pass the break-point. Proper time of contact of chlorine with water must be allowed before applying this test, however, for almost any water will "flash" within the first few minutes following the addition of chlorine assuming, of course, that any residual is present. This test, developed and used by Laux of Anderson, Ind., is known as the "flash test." The point in the curve where the flash first appears is known as the "flash-point."

Disappointing results and operating difficulties with the process may be avoided by first studying the reaction of the water to chlorine treatment. Although, the work is not involved, it does require a certain amount of laboratory skill in order to arrive at the proper conclusions. A favorite method for such a study is to set up a series of samples in glass containers to which are added varying amounts of freshly prepared, standardized chlorine water. At the end of specified time intervals each sample is tested for residuals, taste and odor, color, pH and, at times, for alkalinity. These results are then tabulated or transferred to graph paper as guides to plant practice. The frequency of such a test depends entirely upon the water. Since the water in large reservoirs and lakes is usually more stable and less subject to violent change than the water in streams, frequent complete tests on the former are usually less necessary than on the latter. Plant control tests must, in general, be made more frequently than with marginal chlorination.

Although break-point chlorination has, thus far, been used primarily for the elimination or control of tastes and odors, it can in many instances also be used for color removal purposes. Experience indicates that direct bleaching of up to 70% of the total amount of color present may be obtained when chlorine is added up to the break-point. Beyond this point little additional color removal appears to occur. This effect is more noticeable on highly colored, clean waters than on turbid water. In no case has the process tended to "set" the color. Break-point chlorination ahead of alum treatment often results in better color removals than with alum alone. Pre-chlorination to the break-point frequently so conditions waters containing iron-organic complexes that they will yield more readily to coagulation.

That break-point chlorination is not limited to one section of the country, or to any one type of water, is evidenced by its use in such widely separated places as Newport, R. I.; Tarboro, N. C.; Crossville, Tenn.; Lawrence, Kansas; Great Falls, Montana; Miami, Fla.; Tyler, Texas; Vergennes, Vt.; and Niagara Falls, N. Y. In addition to the taste and odor improvements, many of these users have reported better color removals, better appearing water, and greatly reduced bacterial content over results formerly attained. In some cases these so called secondary benefits have proven of greater importance than the improvements for which the process was instituted.



Four typical "break-point" curves.

Mechanical spreading equipment, loaded with salt, ready for work.

Snow and Ice Removal With Rock Salt in Newark, N. J.

By JOHN S. FLOCKHART

Principal Ass't Engineer, Bureau of Street Cleaning

ACTING under the instructions of James W. Costello, Chief Engineer of the Department of Public Affairs, Newark, New Jersey, Goline Doremus, Deputy Chief Engineer in Charge of the Bureau of Street Cleaning, during the winter of 1938-1939 conducted experiments with rock salt in preventing the formation of ice and snow on some of the principal streets of the city. This proved to be so successful that as a part of the snow removal organization for 1939-1940, a salt spreading detail was formed.

This unit consists of the personnel who are normally assigned to the double shifts worked by the motor pick-up sweepers and hence are available at any hour of the day or night. At the first indication of sleet or snow, these crews report at the Hayes Street City Yard, where the salt is stored and from where the operations are directed. The two large sand spreaders owned by the Bureau are kept at the City Garage filled with salt and ready for immediate action. Four 5-ton dump trucks are equipped with smaller portable spreaders and sent to the yard where they are loaded with salt. If the storm is expected to be particularly severe, empty trucks are also sent to be loaded and a crew of men assigned to spread the salt by hand at dangerous intersections.

Salt is stored in bulk (bulk salt is now being used, but last winter it was handled in 100-lb. bags) in this building which was formerly a stable, but had been converted into a garage for the motor sweepers, sewer and street cleaning tool house, and snow removal headquarters. The capacity of the storage is about 200 tons, which amount is ample, since salt deliveries can be made in 48 hours. In loading, the trucks are backed against the door on the second floor and under

John Flockhart

James W. Costello

Method of loading salt into spreading equipment.

the 12" cast iron pipe, through which the salt is discharged from a bin on the second floor, of 2 tons capacity. This bin is always kept filled and acts as a reservoir when loading operations are not being carried on. A simple wooden gate controls the flow of the salt. The plant employees who do the loading are under shelter in a warm room.

Instructions containing the lists of streets to be salted are given to the operators of the spreaders, with the result that the crews have become thoroughly familiar with the routes they are to follow. Prior to the winter months, meetings were held with all the men connected with the organization and the procedure to be followed carefully outlined and explained. On wide and important arteries such as Broad Street, sketches were drawn, indicating in different colors the sequence of the lanes to be salted.

The salt used is rock salt of "CC" size. Specifications in addition to requiring a NaCl content of not less than 98% also contain the maximum and minimum sizes of the grains as determined by passing through mesh screens. A sufficient stock must be kept on hand by the dealer to supply a minimum of 50 tons for emergencies within 12 hours when requisitioned by the Bureau.

During the past season the value of salt was proved on five occasions. On December 30th, 1939 at 12:30 A. M. when 2½" of snow fell at a temperature of 30°, the salt detail was called into action with four pieces of spreading equipment, and continued operations during the period of the storm. At 7:00 A. M. the main streets had been given a coating of salt which prevented snow or ice from accumulating. Wet pavements, free of ice were the rule. The amount of salt spread on 300,000 square yards of pavement was 81.6 tons or approximately ½ lb. per square yard. In this particular case, the attention of the public was directed by the Bureau of Street Cleaning in the daily press to the effectiveness of the salt in melting the snow as it fell and also to the fact that the ice-free condition of the streets was due to the salt and not just to the action of traffic. More recently during the storms of January 8th and of January 11th, 12th, 17th, 20th, 1940 and subsequently, when the temperatures were from 5° to 17° below freezing, salt spread as the snow fell kept the pavements ice and snow free, during these fairly low temperatures.

Most of the pavement in Newark, and particularly those streets upon which the salt is spread, are of the sheet asphalt type. The opinion of the Bureau of Streets is that sodium chloride as applied in Newark on the bituminous pavements has no deleterious effect. This has recently been substantiated by the Director of the Research Laboratories of Columbia University and by the Public Roads Administration.

The City of Newark has 164 sand boxes, holding approximately 1/3 cubic yard of sand each, placed at points in the City where dangerous conditions might occur due to icy streets. With each cubic yard of sand, 150 pounds of salt are added. It has been found that the salt in the mixture prevents freezing in the storage receptacles and greatly assists in embedding the sand when spread. Salt in the amount of 125 pounds to each cubic yard of sand is used where extensive sanding is required.

The Bureau is convinced that the application of salt on the city streets during a snow storm will so melt the sleet and snow as it falls that many dollars will be saved which heretofore were spent for snow removal by labor and equipment. By working with the storm, the pavement under the action of salt and traffic is kept in better condition with respect to prevention of ice and of bonding of packed snow, since ice does not form and snow does not pack. Time, money and effort are conserved by its use, and a safer driving surface is obtained.

Refuse Collection and Disposal Data

The following information from our readers supplements that published in our June issue on methods of refuse collection and disposal.

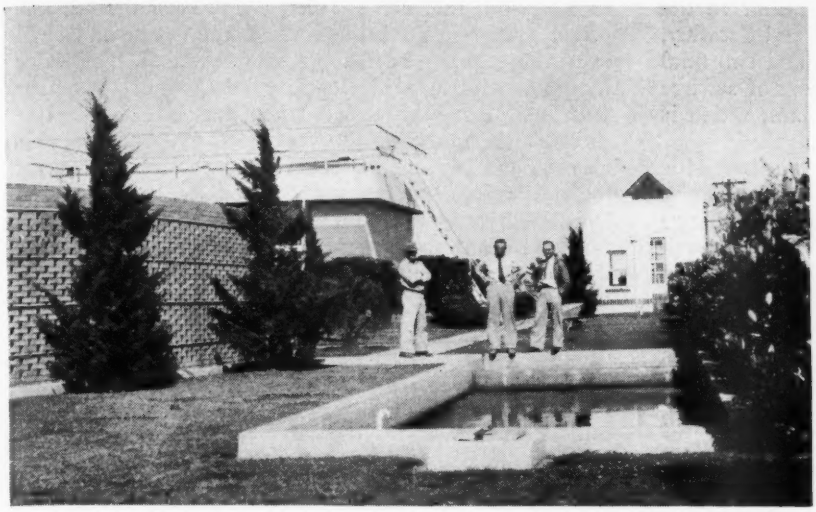
In Marshall, Texas, according to H. J. Graeser, City Manager, dry refuse is disposed of in a deep fill and covered with earth. Garbage is collected by farmers and used for feeding hogs.

M. A. Mayer, Superintendent, Rosebud, Texas, says that bills for garbage collection are sent out with the water bills. In Seymour, Texas, T. E. Craddock, City Manager, the bills are sent out quarterly as a sewer charge. Stamford, Texas, R. G. Bowdry, City Manager, plans to start a city collection system soon and would like information on most commonly used methods and on rates. In Salt Lake City, Utah, W. D. Beers, City Engineer, the city collects from homes of three apartments or less, while with hotels, larger apartments, restaurants, etc., collection is by contract.

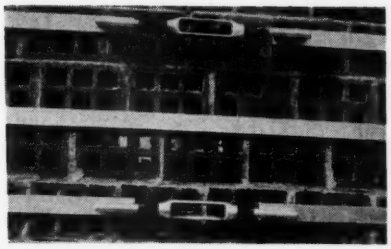
In Manassas, Va., Wm. F. Cocke, Town Manager, householders are required to place garbage in standard 10-gallon galvanized iron cans with close-fitting tops. Cans are taken from the premises to the point of disposal, where they are cleaned and sterilized with steam before being used again. A sterilized can is left in place of each can collected. All private collectors are required to meet the same standards.

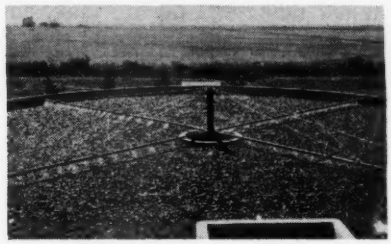
Typical of the troubles incident to collection and removal of garbage is the experience in Hoquiam, Wash., W. L. Lovejoy, City Engineer, who says: Garbage collection in Hoquiam is handled by a contractor who comes on call; he is under contract to pay the city 20% of the gross proceeds. The arrangement is unsatisfactory and will probably be discontinued in the near future. The city has in abeyance a very good ordinance providing for compulsory collection and payment. This provoked a storm of protest when an attempt was made to put it into force a few years ago, but another attempt will, in all probability, he made this year.

In Raymond, Wash., J. E. Buckingham, City Engineer and Water Superintendent, collection is by contract, but the city collects the charge of 25 cents a month, the bills going out monthly with the water bills. The city retains 10% of the amount collected.



Rayne, La.: Final settling tank in foreground: filter with open brick wall; Imhoff tank; and pump station.





Above, close-up of wall: below Rayne filter, with rice fields in rear.

Trickling Filters With Open Sidewalls to Improve Aeration

By L. J. VOORHIES
Consulting Engineer, Baton Rouge, La.

IN DESIGNING a small sewage disposal plant of of the Imhoff tank-trickling filter type, the most economical layout of the plant placed the filter entirely above ground. This suggested the use of a filter wall with perforations to provide free passage of air through the wall and thus improve aeration of the sewage trickling through the filter.

Accordingly a design was prepared using common brick laid lengthwise in the wall with 2″ spaces between the ends of bricks, the holes thus formed through the wall (12″ thick) being staggered with those in adjacent vertical rows of bricks. A disposal plant using this idea was constructed for the town of Rayne, La., with assistance of the Works Progress Administration, and has been in operation since June, 1936.

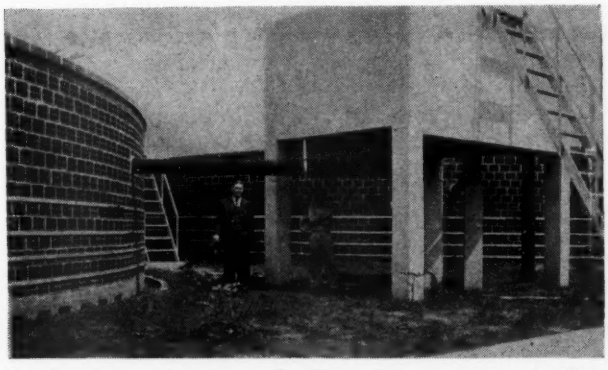
Although no BOD determinations have been made of the sewage treated by the Rayne plant, the effluent of the plant is clear and very stable and no offensive conditions have resulted in the outlet ditch, which winds through the flat country for 15 miles before discharging into a stream. The writer believes the perforated filter wall improves aeration to a worthwhile extent.

In 1938 the writer was called upon to design six sewage disposal plants, and contemplated using perforated filter walls for all of them. This volume of work justified the manufacture of a special vitrified clay block for filter wall construction. Tentative designs submitted to C. R. Payne, manager of the Texarkana plant of W. S. Dickey Clay Mfg. Co., resulted in his company quoting a reasonable price for furnishing such blocks. The design finally adopted calls for a vitrified clay block 9″ wide, 6¼″ high, 12″ long with six 2″ x 2″ cellular openings. Outer faces of block are corrugated to provide good bond with the mortar. The ends of the blocks are cut with a flare of ¼″ in the height of 6¼″, so that when the face of the wall is made vertical, the cellular openings slope downwards approximately ½″ through the width of the wall.

These blocks provide a wall with ventilating openings approximating 37.5% of wall area, compared to 20% for the brick wall used at Rayne plant. To resist the radial thrust of the retained filter stone, circumferential steel bands are placed around the wall at appropriate spacing; and reinforcing steel rods are placed in the horizontal joints of the upper three rows of blocks, above the stone, to control temperature stresses.

Trickling filters with perforated or ventilating vitrified clay block walls have been built under the direction of the writer for the following Louisiana towns:

Ruston	two filters	80 ft. diameter.
Homer	one filter	75 ft. diameter.
Franklin	one filter	76 ft. diameter
St. Martinville	one filter	70 ft. diameter.
Crowley	two filters	80 ft. diameter.
Sulphur	one filter	70 ft. diameter.



Crowley filter and dosing tanks. Note drain vents through filter walls.

All the plants mentioned above are similar in design. All have single units except Ruston and Crowley, which have two Imhoff tanks, two filters and two final settling tanks. All provide for recirculation of sewage through the plant except the Franklin plant, which is located one-half mile from pump station.

At the Crowley plant, which is shown herewith, chlorine solution may be applied at three points in any combination, namely, 1) to raw sewage in discharge manifold of pumps, 2) to the settled sewage between Imhoff tanks and dosing tank, and 3) to the filtered sewage. At times of normal sewage flow, any desired portion of flow may be recirculated through the plant, and at times of excessive flow following heavy rains when outlet ditch carries a large volume of storm water affording ample dilution, any desired portion of flow through the plant may be by-passed ahead of the Imhoff tank and discharged into the outlet ditch.

Constructing a Complicated Grit Chamber

By E. W. DOWNWARD
City Engineer, Bemidji, Minn.

Since our sewer system requires a lift station to lift the raw sewage up and over to our disposal plant, I was given authority by the City Council to design and construct the unit along with an additional trunk line to serve the extreme west side of the city. The only available location for the grit chamber was immediately alongside of our lift station and wet well near the banks of the Mississippi River. The bottom of the excavation is 4 feet below the water level in the river, necessitating the running of pumps continually during the working day. I used a double row of well points between the sheet piling and the forms. This removed the water before it reached the excavation; the sheet piling being water tight helped also.

The location of the grit chamber was not the best from a construction point of view due to many factors: a junction for sewer lines; a control manhole; a bypass line and the lower elevation of the chamber in order to take care of the new trunk line coming in from the west side of the city. All these things made the construction very difficult along with the fact that the present trunk lines and lift station wet well had to be kept in operation. The laws of the state are strict in bypassing sewage unnecessarily and the old bypass line was directly in the center of the proposed grit chamber excavation so this had to be relocated before anything else was done as a bypass is essential (in case of a break down in the plant) to keep from flooding the lower part of the city through its manholes. Also it was necessary to bypass for a period of approximately six hours to lower the present wet well flow line 3 ft. to take care of the lower elevation of the new trunk line.

Another problem was to keep the main trunk operating through a temporary line as this end of the main sewer line interfered with the construction of the grit chamber and had to be removed. This was done by using the new bypass which was built first and inserting a Y connection in the line to divert the flow into the wet well. In running the new trunk line from the control manhole at the end of the grit chamber along its course up through the city, a manhole was constructed where the new line crossed the old trunk line the new line was at a 2.5 feet lower elevation than the old line this enabled me to keep the old line intact (running it through the manhole) until I had everything ready at the grit chamber end. The valve in the control manhole leading into the grit chamber was installed and closed, then the old trunk line through the manhole 300 feet north was broken, this allowed the sewage to travel through this portion of the new trunk line, through the control manhole and into the bypass line and with the end of the bypass plugged temporarily and a Y connection in the line the raw sewage flowed into the wet well. The old control manhole and old entrance to the wet well were taken out to make way for the construction of the grit chamber itself. The grit chamber being completed a tunnel was constructed between the chamber and wet well, then a connecting sewer was laid between the control manhole and the chamber, the valve in the manhole was opened and the unit was in operation.

Laboratory Studies of Textile Mill Wastes Treatment

Laboratory studies have been made on textile mill wastes by the Texas State Department of Health, Bureau of Sanitary Engineering, to determine the source, volume and strength of wastes and to develop methods of disposal. The textile wastes were grouped into four main sources: Indigo wastes, dye house wastes, finisher wastes and slasher wastes. Typical analyses of each are as follows, in parts per million.

Indigo Wastes.—BOD, 120 to 237 ppm.; alkalinity, carbonate, 280 to 400, bicarbonate, 566 to 720, total 966 to 1,000; chlorides, 30 to 56; total solids, 2,070 to 2,462; color intensity, 540 to 900; pH, 9.4 to 9.7. The waste production is about ½ gal. per yard of warp produced, or 153,500 gals. per day, equivalent to 2,065 population, for the plant studied.

Dye House Wastes.—BOD, 285; pH, 9.2; alkalinity, total, 650 to 1,400; chlorides, 106 to 1,340; total solids, 3,636 to 10,976. The waste production is about 7 gallons per yard of warp production, or 90,600 gals. per day. Population equivalent is 2,067.

Finisher Wastes.—BOD, 1,254; Bi-carbonate alkalinity, 1,120; chlorides, 216; total solids, 21,980; color intensity, 2,500; pH, 7.3. Volume is small—about 116 gals. per week.

Slasher Wastes.—BOD, 1,254; alkalinity, bi-carbonate, 440; chlorides, 260; total solids, 88,550; color intensity, 1,000; pH, 7.3. Volume is very small.

The total population equivalent for these wastes is 4,494. The plant studied handles about 100,000 pounds of cotton per week.

Some ten thousand laboratory tests were carried out, including aeration, filtration with various media, chemical precipitation and oxidation. Land disposal was not tried but it was felt that it should be. The most suitable treatment for the indigo wastes was ferric sulphate, using 160 ppm. with 340 ppm. of lime. The cost per day for the 153,500 gallons of this type of waste would be about $2.12. The weaker sulphur dye wastes can be treated with 800 ppm. of copperas and 2,000 ppm. of lime, at a daily cost of $11.08; the stronger sulphur dye wastes would cost about $32.11 per day from treatment, using 1,600 ppm. of ferric sulphate and 3,200 ppm. of lime. The dye waste volume is about 453,000 gpd.

These data were all based on laboratory studies and were intended to be used as guides for the construction of a pilot plant.

Mr. Stanley

Constructing a Sewer in Tunnel

By HENRY M. STANLEY
City Engineer, Clifton Forge, Va.

AT THE TIME that I was appointed City Engineer, early in 1939, some 50% of a 6500-ft. sewer project had been completed. This involved 24-inch, 15-inch and 12-inch trunk sewer. Of the remaining 3,000 feet, as yet uncompleted, about 1600 ft. had to be laid at a depth below the surface of about 39½ ft. Because of the cost and danger of open cuts of this depth, especially when paralleling a main highway, it was decided to tunnel this section.

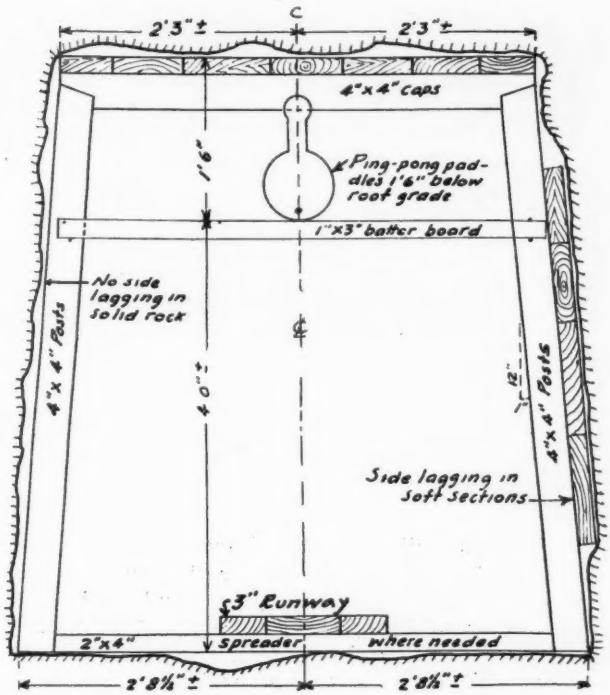
This proposal was immediately checked and approved by both the city and the WPA authorities, this being a WPA project. The sewer was laid in open cut until the depth reached about 13 ft., at which depth the tunnel section was started as this afforded sufficient cover for tunneling. A clear space of about 12 ft. was left in the trench, and a tunnel section 4½ ft. wide and 5½ ft. high was started. Timbering was 4" x 4", spaced every 3 ft. in solid rock sections and every 2 ft. in soft or earth sections. The tunnel was mostly through a hard slate or shale lying at an angle of about 40°, but included soft clay, river jacks or boulders, and soft shale. In the open cut section, screw jacks were used at 5-ft. intervals for bracing.

Shafts were sunk at intervals of about 225 feet. These were about 6 ft. by 8 ft. and were shored with 8" x 8" timbers and sheeted with 2" oak on the outside of the "8 x 8" framing, all the way from the top to the bottom, except for the areas to be tunneled. These shafts were cut with large drills, pavement breakers and air tampers.

In the soft sections, lagging was placed on the top and sides of the timbering, and where needed a spreader was placed at the bottom, low enough to permit laying the pipe without removing it. Longitudinal bracing was placed in soft sections to prevent moving or creeping. The minimum cover was 8 ft. and the maximum was 34 ft. In the clay section, the roofing timbers were of 2" x 10" oak.

In the rock sections, drill holes were located and directed to cut approximately the desired section. Drilling and blasting were carried out, generally, in 4-ft. sections using 40% dynamite, which worked very well. Mucking or carrying out of the waste material presented no particular problem. This was wheeled to the shafts, dumped into a half-barrel bucket and hauled to the top. It was used either to clean up open cut sections or to backfill other tunnel sections. Thus it was unnecessary to remove half of the material from the tunnel, since it was used to backfill adjoining sections. Backfilling was very carefully carried out. In general, a length of pipe of 12 ft. was placed, and this length then backfilled. Timbers were removed from rock sections before backfilling, but were left in place in earth sections. Bulkheads were placed at ends of pipe and backfilling was placed to the roof.

As much as 17 ft. of tunnel per day was driven in the rock sections. In the soft sections, air spades were used in place of blasting. No falls resulted from start to finish in either rock or earth sections.



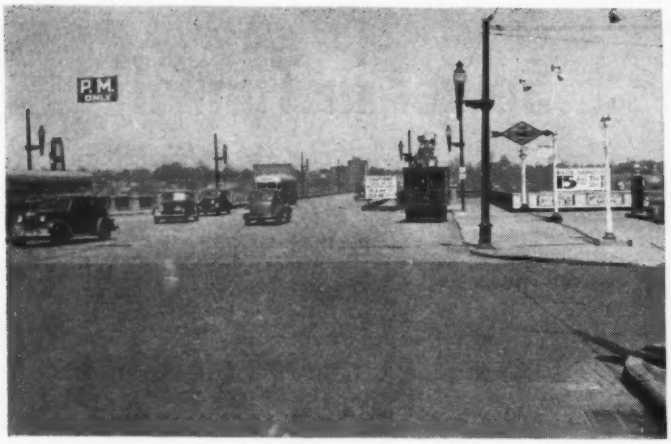
Timbering and grading details

Batter boards were placed 4 ft. above grade at each end of each section, and this line was then carried through, placing temporary 1" x 3" batter boards at about 20-ft. intervals. These could be removed easily and quickly replaced. A 16-gauge wire was used on these batter boards. No trouble was encountered in maintaining the desired grade of 0.70%.

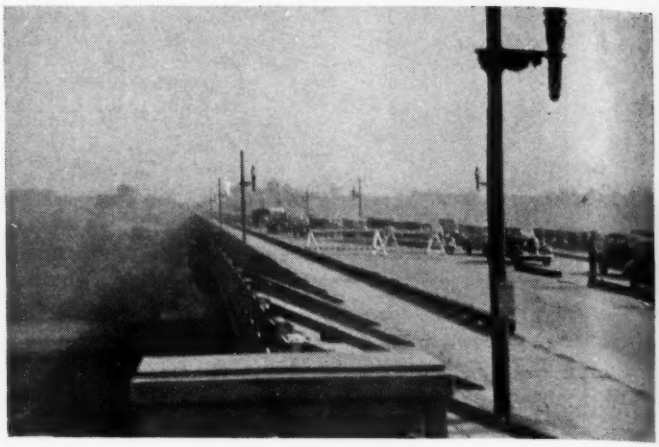
Pipe was lowered into the shafts and then skidded along the runways to the place of laying. Joints were made by pouring with G-K compound. Due to careful handling there was no breakage, and no signs of settlement have appeared at any section.

Ping pong paddles made of masonite were very effective in giving guaranteed accuracy for the heading crews, and added to the novelty of the work; the laborers often remarked that the engineer was "paddling his hole under the ground." These paddles were set in groups of three on about 10-ft. centers, being suspended from the 4" x 4" caps at the centerline, with holes 18 ins. below roof grade. Holes were bored in the paddles, ¼", ½" and 1", the ¼" in the foremost paddle, the 1" in the last. When all the holes in the three paddles lined up and a miner's lamp can be seen through them, the line and grade is accurate.

A Gurley transit with prismatic eyepiece was used; lines were placed using one kind of nail, and the grades by using another kind, thus preventing possible mixups.



Before starting.



The start of the job.

Methods Employed in the Rehabilitation

By RALPH VAN BRIMMER
Bridge Deputy, Summit County, Ohio, Engineering Dept.

THE North Hill Viaduct, Akron, O., is an open-spandrel reinforced concrete arch structure consisting of 16 arches and two beam and girder approach spans, with a total length of 2,840 ft., 130 ft. above the Little Cuyahoga river, which it spans. It carries a 5-lane roadway 52 ft. wide and two 10 ft. sidewalks; also a double-track street railway which has been abandoned and covered with bituminous paving. It was constructed in 1918-1922 and has suffered considerable damage through leaking expansion joints, infiltration of surface water and general deterioration. Because of the height and inaccessibility of the superstructure no repairs were attempted until recently, when a WPA grant was made available for the purpose.

Repairs to the tops of the roadway and sidewalk slabs and the railing are being made from the surface of the bridge; those to the under sides of the slabs and supporting structure, from scaffolds suspended from the bridge floor. Work is carried out in 600 ft. sections on one side of the bridge at a time, leaving two 11-foot lanes for north and south traffic open at all times.

Where roadway and sidewalk slabs are disintegrated beyond repair, the concrete is completely removed, reinforcement steel cleaned (or replaced with new steel if the area has been reduced more than 10% by corrosion) and the slabs repoured with a 1:5 mix of maximum density. The slab ends at most of the expansion joints are badly disintegrated and are being cut back to sound concrete, where ¾" lead sleeve anchor bolts are placed in sufficient number to transfer the stresses, the steel is cleaned or replaced, and the concrete is built up with gunite.

The bitumen-filled expansion joints were leaking badly and are being replaced with sliding plates attached with bronze bolts, and Corten steel troughs welded to the anchor angle and carried to the curb catch any leakage through the joint and carry it to the down-drain provided for scupper discharge.

The expansion ends of the roadway slabs are carried on reinforced concrete brackets with steel bearing plates separated by lead sheets. These plates are so badly rusted that many are inoperative, and the brackets are so badly disintegrated that it is necessary to rebuild them. To do this, the bracket is removed and a pocket cut into the spandrel beam to receive a new bracket and expansion bolts set there, and the bracket is then rebuilt with successive layers of gunite reinforced with 2 x 2 No. 12 wire mesh. A pair of cast leaded bronze plates is then placed on the bracket and the slab and end beam rebuilt over them.

This work and removal of the sidewalk slabs and curb are performed by two crews. One removes the old railing and all the badly disintegrated slabs, and chips out the disintegrated concrete, using a 315 cu. ft. and a 210 cu. ft. air compressors, eight 80 lb. pavement breakers and eight 30 lb. breakers. This crew is followed by a carpenter and concrete crew which install wood forms for new slabs and curb, replace reinforcing steel and repour the slabs.

This crew works on the under side of the sidewalks from a special traveling steel scaffold suspended from the new sidewalk slabs, and from swinging steel scaffolds suspended under the roadway slab. Another crew is equipped with one 315 cu. ft. and one 210 cu. ft. air compressors which operate a gunite and sand blast machine, ten 30 lb. compressed air tools equipped with moil points for chipping, two rock drills and several small paint spray outfits. It removes the forms previously placed; chips disintegrated concrete on the under side of the slabs and from brackets, beams, piers, columns and arch rings; removes loose material and dirt and cleans exposed steel by sand blasting; drills holes, sets anchor bolts and places reinforcing mesh, and builds up the chipped areas with gunite to their original shape; and steam-cleans all areas to be waterproofed. The waterproofing is applied from a similar but smaller scaffold.

The traveling steel scaffold consists of 11 structural

A portion of the completed work.

The new railing.

# of a High Concrete Viaduct

An important reinforced concrete arch structure in Akron, O., was repaired and reconstructed despite difficulties due to height and inaccessibility of superstructure.

steel bents extending across the sidewalk and spaced 6 ft. on centers, and travels on small flanged wheels rolling on railroad rails on wood cross ties laid on the sidewalk slab, and supports a wooden working platform directly under the sidewalk. Each bent is attached to a concrete counterweight at the roadway end to prevent overturning, the counterweights also traveling on the rails. This scaffold is designed for 15,000 lb. live load plus 50% impact and an allowance for an accumulation of chippings; completely equipped, the scaffold weighs approximately 72,000 lb. To reach work outside the arch rings not accessible from this scaffold, swinging scaffolds are dropped from the traveling scaffold. A steel mesh fence entirely encloses the working platform, which is reached from the sidewalk by a set of movable wood steps, and a temporary wood rail at the edge of the sidewalk, provided with a gate, protects the workmen from falling at this point. Upon completion of one section, the entire scaffold, with counterweights is moved ahead by means of a double-drum winch operated by compressed air.

The work under progress.

The roadway slab between the arch ring and the centerline, the cross beams, the arch ring and the arch struts are being repaired from swinging steel scaffolds, supported by 5/8" plow steel cables dropped through 3¼" drill holes through the roadway slab. Five of these scaffolds 12′ x 15′ are in use, being supported adjacent to each other and rigidly connected to form a continuous scaffold 15′ wide and 60′ long. These are raised from the ground level by the air hoist by means of 5/8" cables attached to each corner and passing through the holes in the roadway slabs and over steel sheaves to the drums; and when in position, permanently attached cable hangers, equipped with Roebling open-end couplings are pulled through the drill holes and a locking bar is placed through the coupling; after which the hoist lines are released to be threaded through the next set of drill holes ready to pick up the next scaffold. The 60 lin. feet of swinging scaffold is kept adjacent to the traveling scaffold in order to facilitate the work and make it possible to do all guniting in this area from one machine.

The areas of the completed structure exposed to the weather are being treated with two coats of transparent waterproofing. These areas are first sandblasted to remove surface dirt and loose particles and then cleaned with live steam at 100 lb. pressure to loosen and remove dirt from the surface pores. The waterproofing used is a synthetic resin and tung oil product which is practically colorless and only slightly darkens the concrete and does not change its natural texture and appearance. The waterproofing is be-

ing applied in two coats by air brushing, only enough material being applied to completely fill the surface voids, spraying being discontinued as soon as it begins to show up on the surface. The first coat is applied sparingly and allowed to dry for at least 24 hours. The surface voids are thus partly filled and when dry, prevents the second coat from penetrating too deeply into the concrete. Tests conducted on the selected material showed 1% average dry weight absorption when applied to very porous concrete blocks and subjected to 24-hour immersion in water.

The gunite mix being used is 1:3½ by volume, using local concrete sand which is screened through a ¼" mesh screen on the job just before mixing. Mixing is being done by ½-bag mixers, storage space being provided for but three or four batches at each machine in order to prevent loss of strength due to pre-setting of the cement. High early strength cement has been used in rebuilding the old brackets, as the slab supports used interfere with the installation of expansion joint steel. Concrete shot with high early cement has attained an average strength of over 3,500 lb. per sq. in. at the age of three days, permitting removal of slab supports on the third day and thus facilitating the installation of expansion joints.

The last operation is the erection of the welded steel railing and the application of the field coat of aluminum paint. The roadway surface is patched with bituminous resurfacing over the slabs which were replaced, around the expansion joints, and the holes drilled for the support of the swing steel scaffold. As soon as this work is completed, the roadway is thrown open to traffic in an effort to keep as much of the 52-foot roadway open as possible.

All labor except the skilled nozzleman is provided by the Works Projects Administration, for whom Charles R. Sharp is District Director, E. Lloyd, Area Engineer, and S. C. Breen, Job Superintendent. For Summit County, Arthur F. Ranney is County Engineer, C. A. Babcock is Superintendent and the writer has been in charge of design and field operations.

Road Surfacing Program in King Co., Wash.

Beginning in 1937, King County, Wash., has carried on a program designed to build up its graveled roads with a light bituminous surface treatment. There were two reasons for this step: First, in the interest of economy to produce a system of hard surfaced roads which would reduce annual maintenance costs, and second, to give relief from choking dust during the summer months, according to the annual report of H. H. Sisler, County Engineer.

For the comfort of communities along King County's roads, the latter reason seems most important. To understand why the dust problem exists it must be explained that the building of the road system for the past thirty years saw the use of pit-run material of fine gravel taken from county owned and operated gravel pits at a very low cost. Being fairly heavy in clay, the increase of traffic at high speed, gradually pulverized this surface into a fine dust, creating an unbearable situation to property owners, the traveling public, and ranchers along the road. Not only is this dust troublesome, but it is actually dangerous, because clouds obscure the vision of automobilists and are the direct cause of many fatal accidents.

The bituminous surface treatment is given in three stages, and even before the final seal coat is applied, the economy of this program becomes evident in the reduced cost of maintenance from year to year, by a reduction in the total mileage of graveled roads. The three-stage operation, briefly described, gives these results:

The first stage usually consists of blading the existing surface to a uniform road section by means of a heavy road grader equipped with scarifier when necessary. All loose surface materials are then bladed into windrows along each edge of the road and the surface swept free of dust and dirt. A pressure distributor then is employed to apply a shot of SC No. 2 at the approximate rate of 0.5 gallons per square yard. Immediately following this, the material in the windrows is bladed over the freshly treated surface and broomed until sufficiently set against raveling under traffic. The surface is then further compacted by means of a modern power roller.

Continuing on with the second treatment, the operation consists in patching and leveling the first course, placing a light shot of MC No. 2 oil, about 0.25 gallons per square yard for a tack coat. At the rate of about 100 cubic yards to each mile of 20 foot road, a layer of ¾-inch minus crushed rock aggregate is spread over the roadway surface. During this stage traffic is not excluded from the highway, and after a minimum of five days, during which period rubber tired patrol graders keep the surface evenly covered, a second course of oil and rock aggregate is spread in the same manner as for the first layer.

The final treatment consists in patching and leveling the roadbed, and brooming the surface until clean; then a pressure distributor applies the seal coat, using RC No. 4 at the rate of 0.30 gallons per square yard. This application is then covered with coarse screenings ½-inch to ¼-inch at the rate of about 150 cubic yards to the mile. The surface is then compacted to a uniform section with a ten-ton roller, remaining voids being filled with a spread of fine screenings, ¼-inch to No. 10, at the rate of 50 cubic yards to the mile. The last application of the fine screenings has the advantage of producing a dense mat, giving a smoother, non-skid riding surface, impervious to moisture—a distinct benefit to the county.

New Cement Specifications Recommended

At the annual meeting of the A. S. T. M. in June, Committee C-1 recommended new specifications for portland cement comprising five types, including one for use in general construction, another for high-early-strength, one for use when a low heat of hydration is required, and one for use when high sulfate resistance is required, and one for use when special properties of the three latter types are not required. For all five types the autoclave expansion is set at 0.50 per cent max. A new method of test for autoclave expansion was accepted as tentative.

One important provision was made, namely, that the new portland cement specifications will not become effective until September 2, 1940. Ultimately they will replace the present Standard Specifications for Portland Cement (C 9 — 38) and for High-Early-Strength Portland Cement (C 74 — 39). An important part of the report included details of an investigation of mortars by seven laboratories, the committee in charge concluding that none of the plastic mortars covered in the investigation showed sufficient superiority over the C 109 mortar to warrant a change in type of mortar and it recommended that the Tentative Method of Test for Compressive Strength of Portland Cement Mortars (C 190 — 37 T) be retained.

The Editor's Page

Construction of More Airports Is a National Need

The past year has emphasized in the mind of the nation the need for more airports, and the popular demand for them is producing results. In a forthcoming issue of this magazine the articles will be devoted largely to the problems of airport construction. In the meantime, many cities are going ahead with such work, often with the help of the WPA. Also, word has recently been received through the ARBA that a Federal appropriation for $250,000,000 to $350,000,000 for airport construction is probable in the near future. This money will be spent in the development of a national system of airports.

The construction industry is well equipped to carry on work of this nature. The development of modern dirt-moving machinery has greatly reduced the cost of necessary grading. A million yards of excavation is not unusual for a large port, and the ability to handle this quickly and economically is tremendously important in any program of construction. Paving is a highly important part of construction, and the total area of surfacing in a modern airport is very large—a recent one involved 48,000 sq. yds. of concrete and 250,000 sq. yds. of bituminous paving. Present-day knowledge of subdrainage and the necessity for a firm subbase permits the construction of surfaces with the assurance that they will stand up under the heavy loadings of the larger planes now being used or planned for the near future.

Most airports are located well out from the cities they serve. This involves the construction of adequate water supply and waste disposal facilities. There has been little said, in connection with most airports, regarding these essential facilities. It is to be hoped that they will not be slighted in the present large program for construction.

Carbon Dioxide in the Coagulation of Alkaline Waters

One of the by-products of intensive research in sewage treatment by chemicals has been a better understanding of the difficulties of coagulating, with aluminum sulfate, water of high alkaline content. Many substances have been developed as aids to coagulation; perhaps the time-honored practice has been to overpower the water by adding enough "alum" to reduce the pH. The presence of an excess of alkalinity causes the redissolving of the ordinarily indissoluble aluminum hydroxide floc; in sewage treatment this is usual, and because of the high organic content of the sewage, the addition of more coagulant does not solve the problem even to the imperfect extent that it does in water treatment.

Carbon dioxide has been used for some years now in the recarbonation of lime-softened water in order to prevent deposition of lime on filter sand and in the pipes of the distribution system, it is cheap and effective, and it can be used economically for reducing the amount of aluminum sulfate required for coagulation, and in improving coagulation of highly alkaline waters. It has the advantage over sulfuric acid as a conditioner in that it is probably easier and cheaper to use, though much will depend on the water; certainly it is easy to control. In sewage treatment, carbon dioxide does not affect growth in the digester, as does acid, and is more effective in the higher ranges of alkalinity in obtaining a good floc and a clear effluent. It also reduces the amount of coagulant required by about 50%; just how much saving there will be with alkaline waters remains to be determined by wider practice, but it appears from experience that coagulant dosages can be reduced very considerably, and better results can be obtained.

A Reader Writes an Editorial for Us

"Your editorial on *Timewasters, Our Readers and Their Mental States* was read with some care. Seriously, the percentage of your space used for these problems is so small as to be easily spared by the readers who want the more serious matter for which the magazine is published; and the readers may give the problems as much or as little of their time as they wish. It is my feeling that most of your readers can have plenty of *serious* problems in connection with their work, and that a bit of mental gymnastics done in fun is a far better way of escape from these problems than many of the ways that are commonly taken by workers who are wearied by the monotony or the drudgery or the worry of their tasks. Give us a bit of play for our pencils—play having been defined as 'work that you don't have to do'—and it will not send us home with less money, worse breath or meaner disposition than is natural to us. And if you can make two grins grow where only one (or none) grew before, then Timewasters can be called a public benefactor."

Thank you, Mr. C. N. E. We have taken the liberty of changing only a word or two of what you wrote, which we trust you will pardon. And until or unless Uncle Sam gets us for preparedness service (which looks right possible), Timewasters will continue; and when that happens perhaps we shall call for volunteers to carry on.

Getting Ready for Winter

No sooner does one get accustomed to the summer weather than it is time to get ready for winter. Right now it is almost *past* time to have gone over the motor equipment and made it ready to do the heavy work of plowing snow; to have started the fall maintenance work that will put the highway surfaces in shape to give good service through the cold months; to have ordered those new snowplows; to have checked on drainage and culverts so that water will not stand, freeze and clog the drainage structures; and to have done the thousand other things that always seem to need doing just as you get interested in something else.

Built of junk and scraps, this house is typical of many in project area.

Designing Water, Gas and S

By AUGUST SAUER
Sanitary Engineer

SAN ANTONIO'S recently inaugurated Low-cost Housing Projects propose to do away with large slum areas which have existed within the city limits for many years. These areas, covered with dwellings ranging from run-down frame houses to make-shift shacks, have been inhabited by Mexicans, Negroes and a small proportion of whites.

Sanitary installations were of the most primitive type; sewer and water facilities — installed many years ago to serve but a few houses—were inadequate to meet the needs of an ever growing population within these areas. Municipal ordinances failed to correct conditions so inducive to spread of disease, crime and vice because dealing with each individual was a hopeless task.

By acquiring municipal ownership of these areas and providing well constructed, fireproof dwellings with modern sanitary facilities and by restricting the number of occupants and controlling, by sectional supervision, the general conduct of these occupants, the city hopes to raise the living standards, improve health conditions and, through low rental charges, liquidate the entire enterprise within 50 years.

The undertaking, at this time, comprises five areas, each representing a separate project covering from 8 to 58 acres, with a total of 122 acres. According to the size of each area the number of dwelling units varies from 236 to 932, with a total of 2,554 units, sheltering nearly 13,000 people. Each dwelling unit contains from three to five rooms, accommodating from two to eight occupants with certain allowances in regard to smaller children.

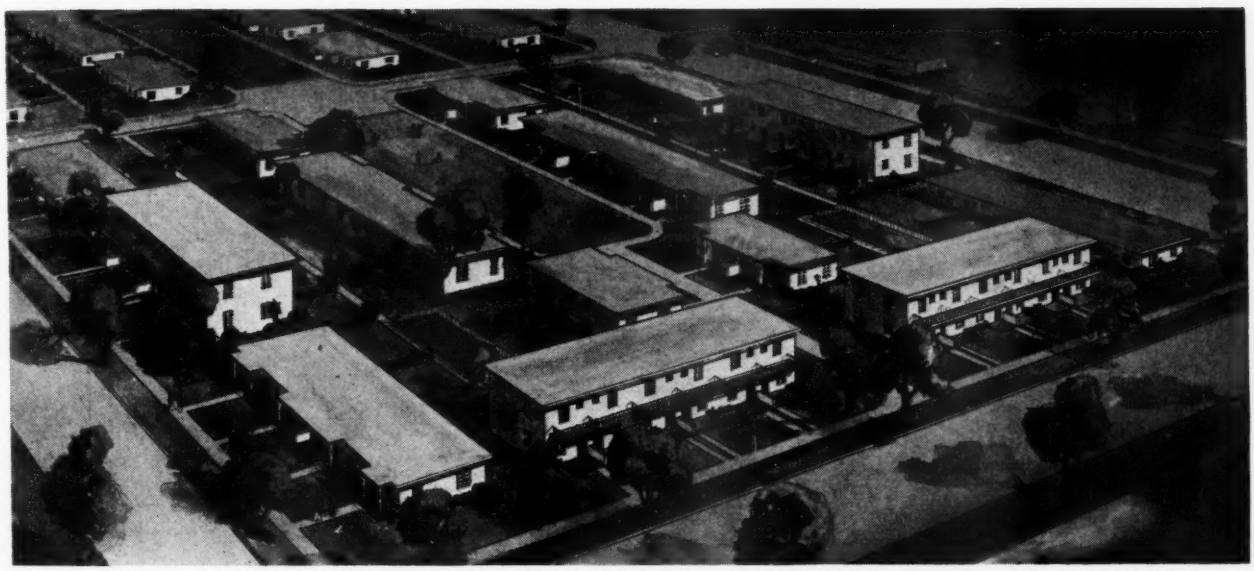
The buildings, to avoid monotony in appearance, are of one story and two story types and contain from two to eight dwelling units each. Each project has its own administration building, service streets, playground and individual yard area for each family.

The area occupied by each project covers several city blocks—some located on the banks of Alazan Creek, a harmless stream during dry weather but a serious problem during rainy seasons; others on terrain so flat that considerable difficulty was encountered in providing grades for new sanitary sewers to be connected to existing mains. Every advantage was taken of existing topography to achieve the most pleasing arrangement of individual groups of buildings and provide, at the same time, proper grading toward gutters and storm sewers. Completion of each

Note steel sash, tile and reinforced concrete. Trees are preserved.

Sewerage Facilities for Low Cost Housing Project

Computations for designing water and gas lines for a large low cost housing project are given, along with other data of value in design and construction.



Architects' preliminary sketch of a typical block.

project will include terracing, landscaping, planting, street lighting, paving and traffic control.

An enterprise of this magnitude, involving many millions of dollars, yet, by its very purpose, requiring sound economy throughout, called for exceptional effort in organization, cooperation and standardization. Requirements of federal, state and local authorities had to be met; architectural and engineering features co-ordinated; preparation of plans and specifications completed within a few months.

The latter task was assigned to several of the city's leading architects and engineers. These, instead of taking their allotted shares of the work to their respective offices, hit upon the simple expedient of forming two temporary organizations, known as "Housing Engineers" and "Housing Architects." They rented offices in the same building for a few months, pooled their equipment, resources and employees and were thus able to complete their individual assignments harmoniously, in a minimum of time and at a financial saving due to the absence of competition for available help, individual expense for increased office space and duplication in blue-printing, typing, etc.

The City Engineer's office, with the cooperation of Public Service Companies, made surveys of the proposed sites and furnished plans showing elevations, grades and locations of existing utilities.

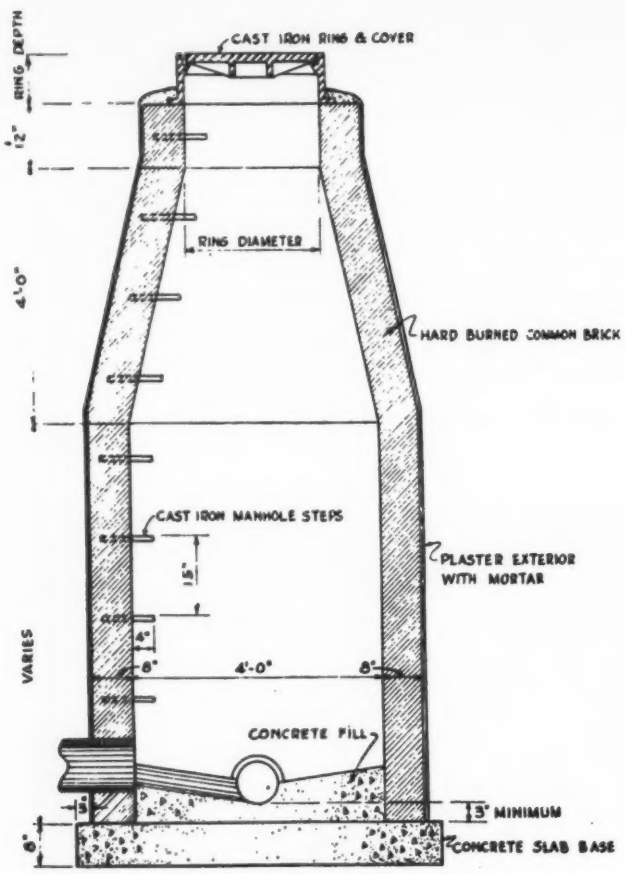
For the purpose of contract awards, plans for each of the five projects are complete in every detail, as are the specifications, which cover over 250 pages. Yet, much of this work had been so standardized that its incorporation into all five projects was possible, without changes. It includes, in particular, details of building construction and details of sewer, water, gas and electrical installations.

While several hundred buildings will be erected under these projects, they have been standardized to twelve types, varying in number of rooms and story height. Fire resisting materials only are used; walls, floors, ceilings and roofs are of tile and concrete; windows are made up of metal sash and even closet shelves and hangers, drainboards and kitchen cabinets are of steel.

Particular attention has been given to installation of piping for gas, water and sewer connections. All such installations are made in strict accordance with City Ordinances, though the city has waived the usual charges for permits.

Piping immediately under the buildings is suspended from the first floor, not less than 12 inches above the ground. No cutting through walls or floors will be necessary as thimbles, sleeves and boxes are accurately placed in position before concrete is poured and the piping is installed before plastering.

Hot and cold water piping is of copper tubing—hard drawn copper for inside installations and heavy



Section of standard manhole.

soft copper underground. Fittings are either cast bronze or cast or wrought copper. Connections between copper tubing and valves to other types of piping or equipment are made with cast or wrought brass, copper or bronze adapters, having solder joints on one end and threaded joints on the other. One 1¼-inch service pipe leads to two units, with 1-inch individual stop and waste valves.

After installation and in accordance with regulations by the State Health Department, the piping is sterilized with a water solution of not less than 500 ppm. available chlorine. A test will be applied, calling for 100 lbs. per sq. inch hydrostatic pressure for a 30-minute period. Only if the pressure drop is not more than two pounds will the installation be considered tight.

The copper service line, including cut-off and drain, located in a cast iron box with spring lock, will reach within five feet of the building line. It will have a brass corporation stop, drilled and tapped into the cast iron main to which it is attached by means of a compression joint with proper fittings. At the cut-off box it will be connected into a malleable iron tee with compression fittings having male pipe threads. Tests for the supply lines require 100 lbs. per sq. inch over a four-hour period with a loss of not more than 200 gallons per inch—mile per 24 hours.

Sterilization of supply mains will be accomplished by the application of a solution of 65% available chlorine mixed at the rate of one pound per 1,000 gallons of water and retained 24 hours.

Gas piping, inside, will be black, soft steel pipe with galvanized malleable iron fittings. Globe valves, designed for 125 lbs. steam working pressure will be used. An air pressure test of 10 lbs. per sq. inch, equal to 20 inches of mercury, over a 15-minute period, will determine if leaks exist. All connections of outside gas piping will be welded and tested at joints with soap suds, under air pressure of 50 lbs. per sq. inch.

Soil, waste and vent stack offsets will be made with 45 degree ells and pitched, horizontally, not less than ¼ inch per foot. All fittings for cast iron soil pipe will be "extra heavy."

Sewer pipes from individual units will be 4-inch diameter on a 1.2% grade. In the service streets, 6-inch diameter sanitary sewers, on a minimum grade of 0.6%, lead to manholes, either existing or newly built over existing sewer lines. In order to save certain trees in the area, the contract specifies that roots one inch or more in thickness may not be cut.

In the design of the water system, upon agreement with Water Board officials, a minimum pressure of 80 lbs. at the city mains was adopted. The minimum pressure permissible at end fixtures is 20 lbs. Demand was based on a maximum of 26 gpm. per dwelling unit, due to the particular type of flush toilet selected, which is rated at 15 gpm. This, with the lavatory, kitchen sink and tub, made a total of four fixtures demanding 26 gpm. Naturally, in application to the whole project, the total had to undergo considerable modification if prohibitive sizes of mains were to be avoided. Obviously not all units would ever use all fixtures at one and the same time. By use of the Probability Curve the Demand Load was reduced to proportions more in keeping with conventional pipe sizes. The forumla used was:

$$P = \frac{Q\ R}{\log.\left(\frac{48}{\log. J} + A\right)} \text{ in which}$$

P=Probability demand
Q=Dwelling units
R=GPM. per unit
J=500, or probability of all fixtures being used at one time equals one chance in 500;
A=Total number of fixtures; equals 4 Q

Assuming, for example, that it is desired to determine the GPM. demand of 28 units, the formula would be:

$$\frac{28 \times 26}{\log.\left(\frac{48}{\log. 500} + 112\right)} = \frac{728}{2.11} = 345 \text{ GPM}$$

This result is then applied to determine the pressure drop in a given length and size of pipe from Saph & Schoders formula:

$$P = \frac{3.68\ V^{1.86}}{d^{1.25}} \text{ in which}$$

P=Pressure drop, in lbs. per sq. inch per 1000 ft of pipe,
V=Velocity, feet per second.
d=Inside diameter

For a 4" dia. pipe, therefore, P equals 35 lbs. per sq. inch per 1000' or for, say, 150' equals 5.3 lbs.

A convenient table, showing diameters, velocities and pressure drops, based on the above formula, can be found in Crane's Catalog # 52, simplifying the necessary calculations.

Thus, beginning with the extreme end unit and advancing to successively larger groups of units which are to be supplied by the main under consideration until the total number is reached, the pipe diameters necessary to keep the pressure drop from becoming excessive is determined.

This method assures adequate pressure for a maxi-

mum demand load; it does not take into account per capita consumption; but assuming the latter at about 50 gpd. average, the design method used provides a safety factor ranging from four to seven. In other words, the installation is adequate to meet a peak consumption of from 200 to 350 gpd per capita—far in excess of what may be reasonably expected. Minimum pressure at end fixtures, therefore, governs in the design of piping.

The supply of gas to each unit was determined by the demands of cook stove, water heater and a variable number of space heaters—depending on the number of rooms per unit—the total being 110 to 125 cfh.

Piping was designed for high pressure from the city mains to pressure reducers and regulators, generally one to each block, and for low pressure between the regulator and individual units. A master meter at the entrance of the high pressure line registers the total gas consumed within the project. However, in order to check average consumption, the low pressure piping at each building is so arranged that a meter may be installed conveniently at any unit. For the present, only one unit in each building will be metered and that only for statistical purposes.

Similar to the method used in the water system, the demand load was established by the use of the Probability formula. The variable factor of space heaters made the computations more intricate and, in addition, two separate groups of calculations were required to determine the pressure losses: one for the high pressure mains, based on pounds per square inch, the other for low pressure piping, based on inches of water.

A minimum pressure of 2½ lbs. at the Public Service Company's mains was adopted for high pressure calculations. Beyond the reducers a maximum low pressure of eight ounces, or 14 inches of water, with an allowable drop of 5.7 ounces, or 9½ inches of water, was used.

Having determined the Probability Demand, the following formulae were used to determine the pressure drop:

For high pressure, from main to reducer,

$$P = \frac{\left[\frac{DL\sqrt{SL}}{4830\ K}\right]^2}{a} = \text{lbs. per sq. inch pressure loss.}$$

For low pressure, from reducer to unit meter,

$$h = \left[\frac{DL\sqrt{SL}}{3550\ K}\right]^2 = \text{inches water,}$$

in which,

DL = Demand load, as determined by Probability formula,

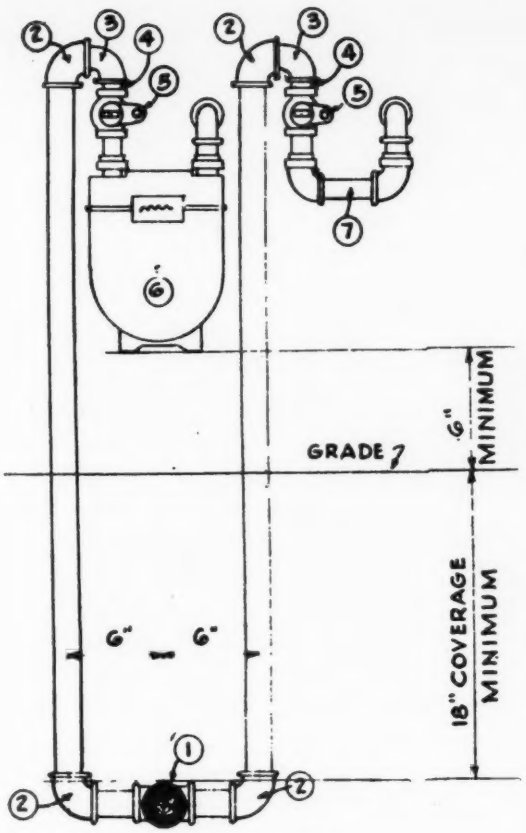
S = Specific gravity of gas; about .58

L = Linear feet of pipe

K = Spitzglass Constants, depending on pipe diameters,

a = average pressure in pipes, in pounds per square inch, minus ½ pressure drop.

All sewer, water and gas connections are made from the rear of the buildings. The position of the buildings is so arranged that the front faces either a public highway or the central area allotted to lawns and playgrounds, with service streets located midway between them. Where this arrangement could not be applied, the sewer lines were located not less than 12 ft. from the building line, with water pipes four feet from the sewer and gas pipes two feet from the water pipes. Since work on sewer lines would start before construction of buildings, it was necessary to tabulate, on the plans, the locations of all laterals. Detail sketches,



Double Meter Setting:

1. 1" x 1" x 1¼" STD. TEE.
2. 1" STD. ELL.
3. 1" STD. STREET ELL.
4. 1" CLOSE NIPPLE
5. 1" L. W. STOP COCK
6. METER
7. CONNECTING LOOP

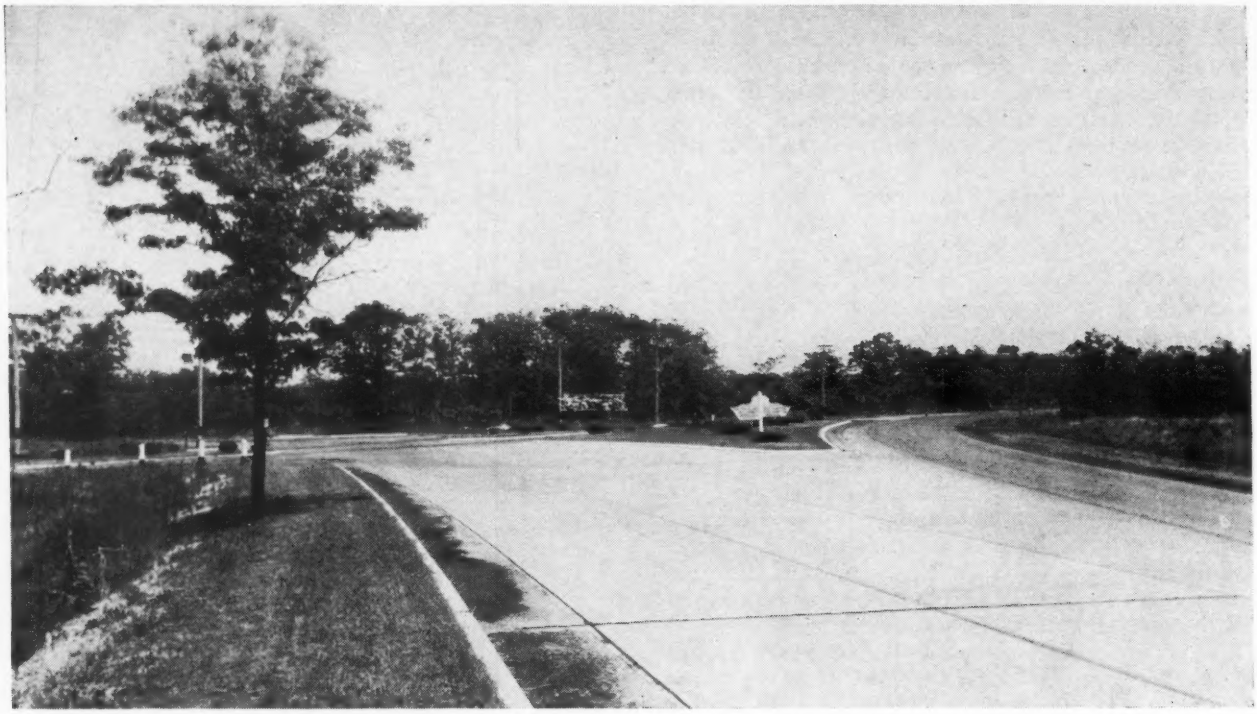
showing the location of all service outlets for each of the 12 types of buildings, made this tabulation assuredly accurate.

Far-flung, indeed, were the many considerations which had to be given to the many aspects of this enterprise. Racial characteristics of proposed occupants, climatic conditions, establishing values for condemned areas, potential up-keep expenses, inevitable overhead charges and many others played their part before work on the plans could begin.

Rents low enough to put them within the means of even the most underprivileged, yet sufficient to cover everything from up-keep to eventual liquidation, were probably the determining factor. On the first project, now well under construction, rents will range from $8.75 per month for a three room apartment, to $11.25 for a five room unit. This includes all utilities: sewer, water, gas and electricity.

Other costs, pro-rated to the average unit include: Land, $369.00; old buildings, $697.00; site improvements, including clearing, paving, all utilities, etc. $526.00; cost of average dwelling unit, $2519.00, of which $2274.00 is for construction and the remainder for carrying charges, overhead, upkeep and all other expenses necessary for liquidation after 50 years.

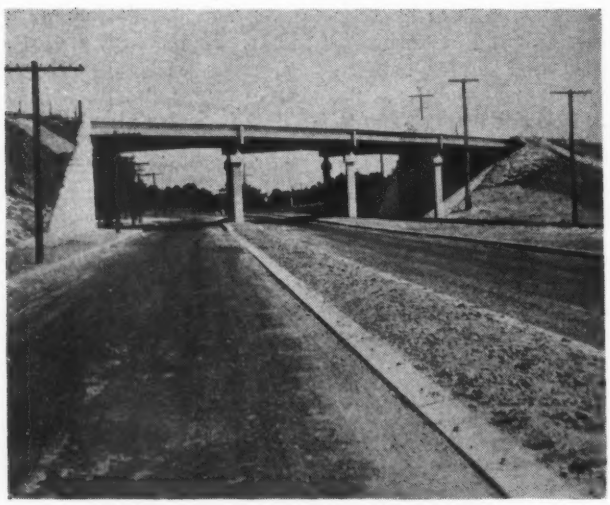
Construction of the remaining projects has begun under the leadership of Ray Mackey, Director of the Housing Authority in San Antonio; J. W. Beretta Engineers, Inc., Chief Engineers; Phelps, Dewees & Simmons, Chief Architects; and Frank T. Drought, Matthew & Kenan, and W. E. Simpson Co., Project Engineers.



Type of roads built in Suffolk County; intersection of Sebonac and Sandy Hollow Roads, Route 39.

Experiences Building and Curing Cement Concrete Roads

By HARRY TUTHILL
County Superintendent of Highways, Suffolk County, New York



Horse Block grade crossing elimination.

WE DO NOT believe it is in order for us to say that we in Suffolk County have found a universal cure for the unsatisfactory results that sometimes take place in constructing concrete pavements. In the words of the Greek philosopher, Syrus, "You cannot put the same shoe on every foot."

There are so many operations in the construction of a concrete pavement that are either not appreciated or cannot be accurately controlled—plus differences in topography, atmospheric conditions, temperature ranges, subgrade soils and materials—that an ideal concreting formula for one highway department may meet with only mediocre success under the different conditions experienced by some other department. Certain aids to better concreting are fundamental, however, and it is with this in mind that we report on the results we have obtained in Suffolk County.

Suffolk County's concrete paving program may be said to have started in 1930, at which time the county highway department was established. Today, we have 127 miles of concrete pavement, comprising nearly 90 percent of the total county road mileage. The paving has been uniformly successful and we have had no failures, scaling or checking in any pavement to date.

The following highlights from our specifications are of interest, as they are in part, at least, responsible for the resulting good work:

Equipment—Only weight batching apparatus approved by the Superintendent will be allowed . . . Bins must be equipped with an auxiliary volume control so arranged as to provide for the convenient removal of excess material in case of overloading in order that the beam or dial may be brought to the proper balance for each batch . . . The scales shall be checked for the balances from two to five times daily.

Composition—The concrete shall be composed of one part of Portland Cement; not more than one and three-quarters parts of fine aggregate; not less than three and one-quarter parts of (broken stone) coarse aggregate. Each cubic yard of concrete in place shall contain not less than 6.6 bags of cement . . . The ratio of fine to coarse aggregate may be varied slightly in order to secure maximum density or to promote workability, providing the weight of the fine aggregate is not changed by more

You Can Write the Order

THAT WILL END SEWER TROUBLES!

OFFICE OF PUBLIC WORKS

Jim —

Let's reline that old sewer with Asbestos-Bonded Armco Sewer Pipe. Then we can stop this continual maintenance expense and have a permanent job at less than half the cost of building a new sewer.

Mac

Here's a way to solve those difficult sewer problems once and for all. Specify Asbestos-Bonded ARMCO Sewer Pipe for economical repair work or new construction.

Asbestos-Bonded ARMCO Pipe meets every sewer line requirement. Its flexible corrugated design eliminates breakage and strong, tight joints greatly reduce the danger of infiltration. Long lengths mean fewer joints per mile and lower installation costs. Cradling is unnecessary.

Also important, ARMCO Sewer Pipe brings assurance of material durability. The galvanized ARMCO Ingot Iron is proved by a 33-year service record in sewers. Now a thick pavement in the bottom and full bituminous coating inseparably bonded to the pipe offer much longer service.

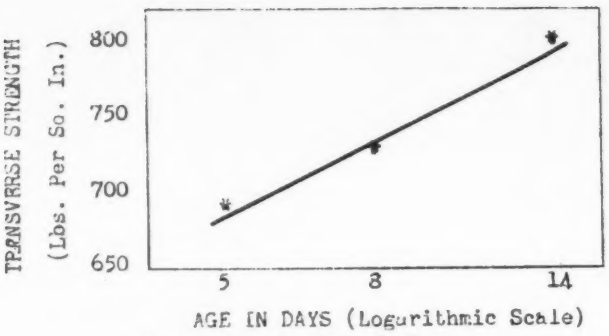
Many major cities have benefited by installing Asbestos-Bonded ARMCO Sewer Pipe. Yours can too. A request to us will bring you complete information with no obligation. Armco Drainage Products Association, 5010 Curtis St., Middletown, Ohio.

A disintegrating brick sewer is permanently repaired with Asbestos-Bonded ARMCO Sewer Pipe. Approximately 600 feet of 72-inch ARMCO Pipe was threaded into the sewer without interrupting street traffic and at less than half the cost of rebuilding.

ASBESTOS-BONDED ARMCO SEWER PIPE

ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 65-67



Typical Concrete Strength Curve.

than ten percent, and providing the combined weight of coarse and fine aggregate is constant.

MIXING—All equipment necessary for the laying of pavement must be on hand and must be inspected and approved before concreting operations are begun by the Contractor . . . The period of mixing shall be not less than 1¼ minutes after all solid material is in the drum and during this period the drum shall make not less than 15 nor more than 23 revolutions . . . The concrete shall have cohesive, plastic consistency that will permit of easy handling and proper finishing. When deposited upon the subgrade, it must remain in a conical pile and not flatten out. The coarse aggregate shall be uniformly coated with a thick film of mortar which must firmly adhere to the coarse aggregate. There shall be no evidence of the separation of the fine and coarse aggregate during handling and finishing, or the formation of surplus water on the surface of the concrete in pools or small spots after belting and before brooming. The quantity of mixing water, exclusive of that contained in the aggregates, shall be determined by the Engineer, and shall not be varied without his consent.

Naturally, we believe that our specifications are right and that our system of control is efficient, but we must also give credit to the curing method we have employed in every mile of pavement constructed. The integral use of a 2 per cent solution of calcium chloride as a curing method for Suffolk County pavements is covered as follows in our concreting specifications:

Calcium Chloride—The solution which is to be added to the mix shall contain four pounds of the flake calcium chloride per gallon of solution. It shall be made by filling a fifty gallon barrel about three-quarters full of water, adding two hundred pounds of calcium chloride, and stirring until the material is dissolved. Enough additional water shall then be added to fill the fifty gallon barrel and the whole stirred until the solution is uniform through out. The fifty gallons of solution will then contain four pounds of calcium chloride per gallon, or one pound per quart.

The solution of calcium chloride shall be added to the mix in proportion of two quarts of the solution for each bag of cement in the mix. The solution must be added as a part of the mixing water, and the amount of mixing water which is generally required shall be reduced by an amount equal to the quantity of solution which is added. A positive method, approved by the Engineer, shall be used for adding the solution in the drum of the mixer, at the time of mixing each batch of concrete, and it shall always accompany or follow the addition of the required mixing water.

It will not be required to cure the concrete after laying by using water or moistened straw or earth, but during warm weather, the concrete shall be covered immediately after finishing, with two layers of wet burlap, and this burlap shall be kept wet for a period of thirty-six hours after laying . . . Precautions will be taken to finish and edge the concrete promptly after placing, as concrete containing an admixture of calcium chloride hardens rapidly.

The writer has had extensive experience with the integral use of calcium chloride for concrete curing since 1924, having been a consultant on construction and maintenance of concrete roads with the State Highway Department of Connecticut. It was on the basis of these previous satisfactory results that calcium chloride curing was included in Suffolk County's specifications.

Our methods of control in construction of concrete pavement are closely followed by the Testing Engineer, who collaborates with the Project Engineer on proportioning of material as well as on inspection and testing. Modulus of rupture determinations are made on test beams in the field during the construction period by means of a Tinius Olsen Testing Machine and in accordance with A. S. T. M. specification C-78-38.

The test beams are cast from representative batches taken from the concrete mixtures and are 6"x6"x42". With this length, we are able to obtain two tests per beam, making the determinations show the tension at the extreme fibre of the beam tested. Tests are made for strengths at ages of 5 days and up to 14 days.

The accompanying graph, based on 22 tests made in the field during October, 1939, indicates the average strengths of concrete specimens at 5, 8 and 14 days. It shows average strengths of 690 lbs. per sq. in. at 5 days, 727 lbs. at 8 days, and 803 lbs. at 14 days.

Since the standard specifications of most state highway departments permit pavement opening at strengths of 600 to 650 lbs. per sq. in., it may be seen that Suffolk County pavements are, at the early age of 5 days, well above the usually accepted opening requirement. Also directly attributable to this method of curing is the high compressive strength of 5500 lbs. per sq. in. which is the average revealed in drill core tests made on all projects.

Situated at the eastern end and comprising somewhat more than half of Long Island, Suffolk County is subject to many variations of atmospheric conditions, including humidity and air currents. Under these conditions, some highway departments have experienced hair-checking, particularly when dry, windy days cause rapid drying of the concrete between the time of finishing and the time wet burlap is applied. This hair-checking has never occurred in our pavements, and we attribute its non-occurrence to the method of curing we employ.

We use calcium chloride with equally satisfactory results in the construction of concrete bridges and curbing, and find that it not only facilitates construction, but gives us higher strength and better quality concrete.

Since its organization in 1930, Suffolk County's highway department has grown to include divisions of construction, maintenance, bridges, testing, laboratory, and accounting. With an annual allocation of road fund monies from the State amounting to $500,000 annually, the construction and maintenance of concrete pavements has been our major problem.

The department to date has constructed 127 miles of this type of pavement, and the results convince us that we have found many of the answers to good concreting. Incidentally, calcium chloride treated abrasives have been used for ice control on Suffolk County concrete roads for the past five years—with no signs of detrimental effect.

New Municipal Garage for Cincinnati

A new $500,000 municipal garage, including inspection lanes for testing, maintenance and repair of all city-owned motor equipment as well as for compulsory semiannual inspection of all citizen-owned motor vehicles, has officially opened in Cincinnati. About 400 batteries and 400 rotary brooms for street cleaning equipment will be made annually in the garage, and a stock of $15,000 in motor parts will be carried.—Public Management.

BETTER CONCRETE IN SHORTER TIME WITH CALCIUM CHLORIDE IN THE MIX

The Results of Actual Field Tests Show

● 63% GREATER 3-DAY STRENGTH

Follow the arrow No. 1; note that concrete with calcium chloride had 675 lbs. transverse strength at 3 days (well above usual state requirements for pavement opening) as against 415 lbs. for plain concrete, a gain of 63% by use of calcium chloride.

● 4-HOUR REDUCTION IN FINISHING TIME

The reduction in time to reach minimum stiffening for effective final finishing shown at the point of arrow No. 2 — X to Y — approximately four hours — permits, as in this case, a saving in finishing costs sufficient to pay for the calcium chloride.

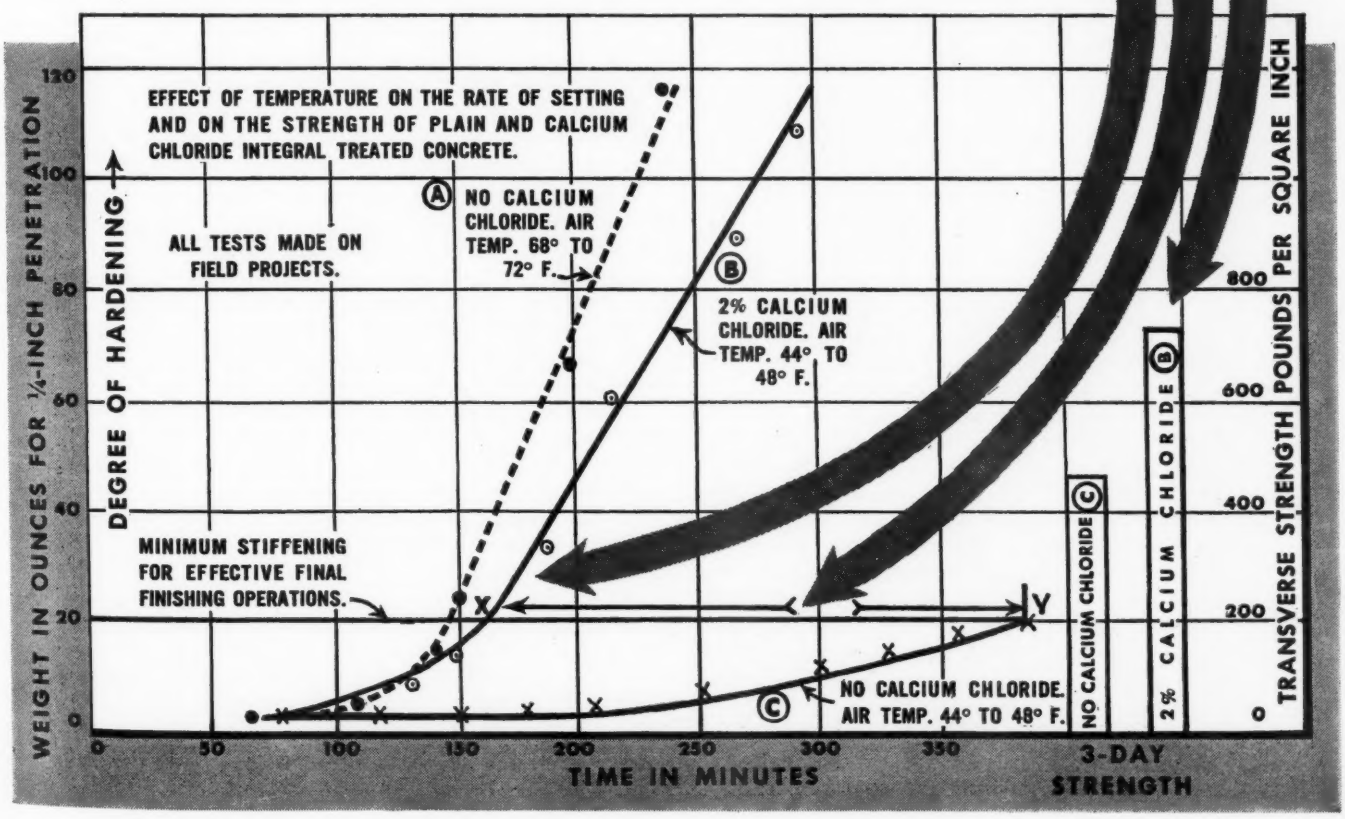
● MAKES UP 24° TEMPERATURE DIFFERENCE TO GIVE IDEAL CONDITIONS

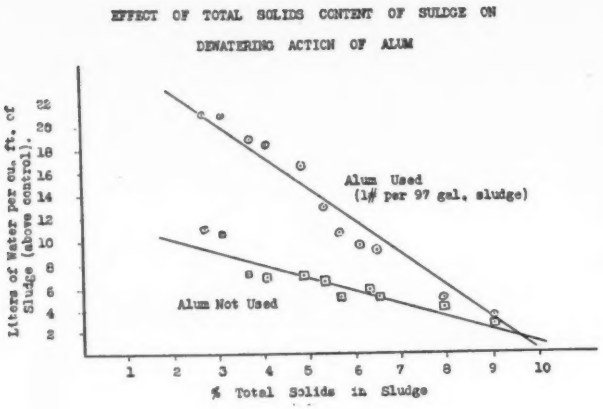
Follow arrow No. 3; note that calcium chloride treated concrete placed at air temperature of 44-48° acquired necessary stiffness for finishing in almost exactly the same time as plain concrete placed at air temperature 70°. Calcium chloride thus practically offsets the usual considerable strength losses in concrete poured at from 60 down to 40 degrees.

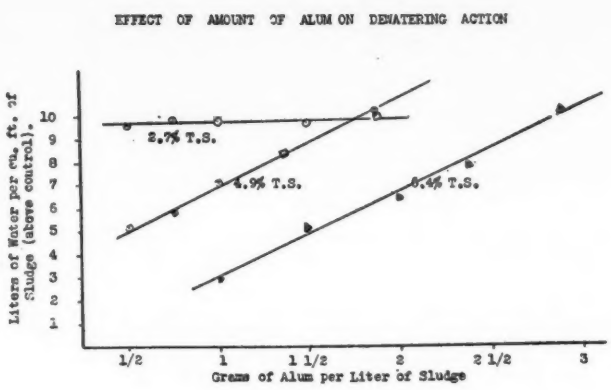
To attain these beneficial results is both economical and simple. Two pounds of calcium chloride (costing 2 to 3 cents) per bag of cement should be added to the concrete mix, and can be introduced, in flake form, directly into the skip. Innumerable field tests have shown that the addition of calcium chloride will produce normal summer reaction in cold weather concrete, with correspondingly high early strength, thus permitting earlier finishing and quicker removal of forms. It will also improve density and water resistance, make concrete flow and fill forms better and produce the high early strength so important in cool to freezing temperature ranges. A detailed description of the penetration apparatus and procedure used in these tests, and literature on the use of calcium chloride in concreting are available on request.

CALCIUM CHLORIDE ASSOCIATION

4145 PENOBSCOT BUILDING, DETROIT, MICHIGAN




EFFECT OF TOTAL SOLIDS CONTENT OF SULDGE ON
DEWATERING ACTION OF ALUM
Liters of Water per cu. ft. of Sludge (above control).
Alum Used
(1# per 97 gal. sludge)
Alum Not Used
% Total Solids in Sludge


EFFECT OF AMOUNT OF ALUM ON DEWATERING ACTION
Liters of Water per cu. ft. of Sludge (above control).
2.7% T.S.
4.9% T.S.
6.4% T.S.
Grams of Alum per Liter of Sludge

Use of Alum in Sludge Drying at Aurora

THE following notes on the use of alum in sludge drying are taken from a talk given by Walter Sperry, Superintendent of the Aurora Sanitary District, at the Northern Section Operator's Meeting at Rochelle, Ill., June 5, 1940. The results were obtained from laboratory and plant scale experiments conducted at the Aurora plant. Mr. Sperry emphasized the fact that the conclusions were entirely his own, obtained under conditions existing at Aurora, and may not be strictly applicable to other plants. The Aurora plant is a separate sludge digestion-trickling filter type plant having 2-stage heated digestion. Unless otherwise noted, the results indicated were obtained on well-digested Aurora sludge. (These notes appeared in the publication of the Illinois State Dept. of Health.—Ed.)

First Attempts.—Bulging digesters and unfavorable sludge drying weather precipitated the first trial of alum. Early in November, 1939, the first alum-sludge mixture was drawn to the beds and the resulting shortened drying time proved to be a life-saver. On this initial trial, one pound of alum was added to each 85-90 gallons of sludge. The success of this first trial of alum prompted the idea of experimenting to determine the optimum alum dosages and to discover the best methods of its use.

How Does it Work?—To date no one seems to know exactly how alum causes the separation of the sludge and water. It appears that in addition to forming a floc which tends to float the solids to the top of the sludge liquor, thus separating the solids and water, alum also exerts a physical action on the sludge-gel, causing the gel to break down, releasing the water. This "breaking action" of the separating water and solids can be clearly observed when the alum-sludge mixture flows onto the sludge bed.

From Bottles to Beds.—Since bottles are easier to "play with" than sludge beds, a series of laboratory bottle tests were set up for the experimenting. The bottoms of one-gallon glass bottles were snapped off and a piece of muslin tied over the bottle mouth. When inverted and filled with sludge, these made excellent miniature sludge beds in which to try out the various sludge-alum mixtures. By measuring the amount of water draining from each sludge filled bottle, relative dewatering effects of various sludge-alum concentrations were observed. Tests were made in which varying amounts of alum were added to a given sludge, in which sludges of different solids concentrations were used with varying amounts of alum, and in which the effects of pH and mixing were observed. The use of the other coagulants was also explored, ferric chloride, ferric nitrate, ferric sulphate, ferrous sulphate and activated carbon all being checked for effectiveness, in the bottle experiments. Digested sludge from the Geneva and Batavia activated sludge plants were tested in similar fashion, with results substantially the same as those obtained with the Aurora sludge.

Using the laboratory bottle results as a guide, plant-scale experiments with the sludge beds were started and in nearly all instances the results obtained were in accord with those observed in the bottle experiments. The conclusions drawn from the bottle experiments and confirmed by the plant-scale tests are listed below.

Mixing.—A short mixing period was found to be the first requirement for the successful use of alum. Prolonged mixing, as other investigators have discovered, materially reduces the dewatering effect of the alum. To reduce the mixing period to a minimum a 20" length of furnace pipe was inserted in the bed outlet end of the sludge pipe and the alum introduced at the inlet end of this short pipe. The mixing obtained as the sludge moved through the furnace pipe and as it splashed and rolled along the bed was sufficient for the Aurora sludge.

The most satisfactory method devised for adding the alum to the sludge was to dissolve the alum in barrels and pump the solution, with a pitcher pump, into an ordinary tin funnel, which was connected to the sludge pipe by a length of rubber hose. Thus by adjusting the pumping rate to the sludge flow and the bed size, a positive and uniform dstribution of alum was obtained. Orifice methods of adding alum gave varying feed rates and caused constant trouble from clogging.

Portrait of a Sludge Bed.—A marked difference was observed in the appearance of a bed of alum-sludge and one of plain sludge. A bed of sludge without alum has a slick, watery, lakelike surface when drawn.

(Please turn to page 31)

Our Readers Want to Know—
52 Questions on Water and Sewerage

IT IS the pleasure and privilege of the Editors of PUBLIC WORKS to receive many questions from its readers. These are answered immediately and directly, and as fully as possible. In some cases the experience of many is far better than the knowledge of a few. Below are given a list of recent typical water works questions (with a few on sewerage) in the hope that our readers will write and give us their experiences in brief. Questions on other subjects will appear in forthcoming issues.

These questions were among those received between Aug. 1 and the time this issue went to press; practically all have been answered directly, but many of the questions (especially 11, 21 and 30) need the cooperation of our readers for best information. In writing to us, please refer to the number of the question below. If you have questions, do not hesitate to ask us for information; but when you ask, send with your question full data to help us in answering. This saves time and correspondence. Air mail and telegraphic requests for information are answered the same day and by the same method.

1 "A well water has a temperature of 150°F, the pressure of the water is 110 lbs.; and the water is high in sulfates. What treatment is desirable." *Well,* we're still looking this up; contributions gratefully received.

2 "Information is wanted on chlorinated copperas." This has been sent; any additional data, including that from manufacturers will be forwarded. Pretty good information in PW, April, 1938, p. 29.

3 "Want information on cathodic protection of steel tanks." It is being sent; experiences of our readers will be doubly welcome. Manufacturer's data will be forwarded if sent to us for rehandling.

4 "I would like to know the best method of cleaning silt from an impounding reservoir." No data on size of reservoir; small community. Experiences will be welcome.

5 This is one of a number who asked for and were sent "Swimming pool data."

6 "Where to buy a 200-gallon per minute pump driven by a water motor?" We haven't found out yet, and all data will be gladly forwarded.

7 "What is the best method and estimated cost of covering a stand-pipe?" We have written for more information; in the meantime experiences and data gladly received.

8 "Where can I find elementary and understandable information on chemistry for the water and sewage plant man without special training in this line?" A fair question; an elementary text on this subject is now under preparation and will be published as one of our "complete-in-one-issue" articles in December PUBLIC WORKS. Order your copy now and avoid the rush.

9 Here is one for the experts, and contributions will be gladly received: "How can I chlorinate an alkaline water without taste production?" If we recall this water correctly, it is high in salinity also—much dissolved mineral matter.

10 "What is the best procedure to follow to reduce iron content of our water?" We need more data for specific aid and have written for it.

11 "How do I proceed to set up meter rates?" Lots of our readers should know this, and we hope they will write us. All data will be passed on.

12 Another wants information on swimming pools. Sent.

13 "Information on taste and odor control." We hope the articles in this issue by Messrs. Griffin and Sigworth will help.

14 "What can you tell me on the bulking of activated sludge." Our recollection is that E. J. M. Berg covered this quite well in our July, 1939, issue, which has been sent.

15 "Please send us prices on inside coated pipe." In response to this question we have asked for fuller data on exactly the kind of pipe wanted.

16 "I would like information and prices on lump alum, Ajax alum and activated alum." The manufacturers have been asked to supply this.

17 "Where can I buy a good asbestos rope to pour calking lead with?" We should like to hear from our readers on this, and will be glad to forward manufacturer's data—within reason.

18 "What treatment is available for removing tubercles chemically — not mechanically?" We should like to have our readers contribute their experiences on this.

19 "From time to time gas appears in our water, causing odor and taste; what treatment is best?" This is from a Michigan water works superintendent. All contributions of experience will be welcomed.

20 "Please send data on break point chlorination." We hope Mr. Griffin's article will help; if more information is desired we are sure Mr. Griffin can supply it.

21 From the mid-west: "How can I clean my mains to get rid of manganese deposits?" What has been our readers' experience in this? We should be glad to have letters to add to the data already sent.

22 "I would like to have literature on a portable hoist of about 8 tons capacity." Additional literature sent to us will be forwarded.

23 "What is the possibility of increasing filter runs by using coal in place of sand?" Sounds like a call for Homer Turner; no doubt he can write a lot more on the subject than we did, but we didn't do so poorly.

24 "I would like information on a wash water tank?" We need a little more information to answer that properly and have written for it. Data will be forwarded.

25 This next one from the deep South is complicated: "Data requested on an air compressor;

condensing water traps; and automatic air traps for priming centrifugal pumps (hot water)."

26 "Information is requested on elevated storage tanks in low pressure areas." A big order; Jack O'Leary could handle this better than we.

27 "What is the best way to get rid of waste lime sludge?" Frankly we don't know, though we didn't admit it in our reply. A timely flood in the river is probably the best solution.

28 This is another request for help in iron removal like question 10. We need and have asked for more detailed information to outline the best practice for the particular problem.

29 "What is the best method for reducing grease in sewage?" Aeration and dry chlorine gas do a good job, and some details have been sent.

30 "What is the best method of flushing the dead ends of our water mains?" What are the practices of our readers in this regard? We shall be glad to hear from a number of them.

31 This is a request for prices on laboratory equipment. These have been sent.

32 This is another request for information on procedure in taste and odor control. Data have been sent, and articles in this issue should help.

33 "Please send late design data on Imhoff tanks and accessories." Sent; but the inquirer should check with his state sanitary engineer.

34 "Advise on electro rust proofing." See question 3.

35 "What is the best way to clean out a limestone well 300 feet deep?" Our reader's report indicates that a second well nearby may interfere with this well. What have been our readers' experiences in cleaning out such wells?

36 A reader reports that one of his wells is slightly sulfur and asks how he can prevent odor. Aeration is about the best, with chlorination to subdue the residue after aeration. Readers' experiences will be welcome.

37 "How can I protect the water system from sabotage?" This is a timely question. The NEWWA has prepared a preliminary report on this, to which the inquirer has been referred. An article especially designed for the small plant will appear soon in P. W.

38 A reader wants prices and data on air relief valves to install at high points in pipe lines to prevent interference and air-locking. This has been sent with some additional information on their use.

39 A reader from the southwest wants something to help him in short school work. Two excellent booklets are available from Solvay—Water Analysis and Alkalies and Chlorine, which have been sent; and his attention has been called to the "Operation" texts published by this magazine.

40 "Where can I get a 5-hp. water turbine?" We are not sure but have queried some manufacturers. We will be glad to forward data.

41 A western reader wants information on "automatic remote control of widely separated pumping stations." Considerable data have been forwarded, and we will be glad to pass on experiences from our readers and pertinent data from manufacturers.

42 "How can I protect and repair the concrete surface of a concrete reservoir; and how shall I cover a reservoir 100 feet by 200 feet?" Procedures and materials for repair have been suggested, but we need more information on the cover situation, and this has been asked for.

43 A reader writes in to ask how to operate a pressure filter. The manufacturer of the filter should be consulted, but we are sending some information.

44 This reader asks for help in regard to elementary water and sewage chemistry. See question 8.

45 "How can I get rid of bad tasting water in dead end lines?" Information has been sent; experiences of our readers will be welcomed.

46 "Can you give me information on how to measure and compute evaporation from water surfaces?" The U. S. Department of Agriculture will help on this; the Water Works Handbook (Flinn, Weston & Bogert), 3rd edition, page 33, gives all the commonly used formulas.

47 "Where can I buy a low-priced colorimeter?" A list of firms supplying colorimeters has been sent.

48 "What system, method or equipment is most satisfactory for lifting water 25 or 30 feet and pumping against a head of 85 lbs.?" It is better not to try to lift over 22 feet or so, and the type of pump that will be best may depend on the variations in water demand.

49 "Please have other Water Departments send me their forms to be used in building up our cost system." We hope our readers will send samples of their forms to A. W. Foster, Water Cost Clerk, Wheeling, W. Va.

50 "How can I eliminate red or rusty water?" It looks as though corrosive water was causing the trouble. Lime treatment should help; maybe Calgon would do the trick. Quite full information has been sent.

51 "How can I make a tight joint between the old bottom and a new wall in our reservoir?" We should like to have our readers' experiences to add to the information we have sent.

52 This reader asks for information on sewage plant operation. We know of no better text than the one published in PUBLIC WORKS for September, 1938.

Refuse Collection and Disposal

Data for 165 cities show that 20 per cent of the cities collect all refuse together, another 20 per cent collect garbage and combustible rubbish in one collection and ashes and non-combustible rubbish in another, and still another 20 per cent collect garbage in one collection and all rubbish and ashes in another. These percentages are fairly constant, regardless of population group. In cities collecting garbage alone, summer collections are three times a week in 20 per cent of the cities, twice a week in half the cities, and once a week in 20 per cent of the cities. Forty per cent of the cities collecting garbage dispose of it by incineration, 35 per cent employ hog-feeding, and 10 per cent use open dumping.

The above is condensed from the 1940 edition of the Municipal Year Book.

Disposal of Tin Cans At Los Angeles

Los Angeles collects, with the garbage, several thousand tons of tin cans a month, which are disposed of by contract by the Los Angeles Byproducts Co. This company reclaims the tin by putting the cans through a heating furnace, then runs the de-tinned cans through a shredder, after which the metal is

pressed into bales 18″ x 15″ under a pressure of 300 tons, each bale weighing about 200 lb. The bales are sold to open hearth mills. Auto bodies and fenders also are shredded and baled in the same way.

The operators are paid on a tonnage basis, each bale being weighed. This weighing is performed by the most unusual feature of the plant, the weight of each bale being printed automatically as they cross the scales platform at the rate of about three a minute. A Fairbanks dial scale is used, provided with a chart graduated to 500 lb. by 1 lb. intervals, and with a Printomatic with time clock and one bank of letters, one of numbers and a third of special symbols. A section of roller conveyor is mounted on the scale platform, carrying an endless belt 36″ wide and 9 ft. long that passes over the platform and under the scale box, moving continuously at the rate of about 12 ft. a minute. As each bale leaves the press it drops onto the belt and is carried across the scale platform. As it passes the center of the platform it intercepts a beam of light to a photo-electric cell, which automatically trips the printing mechanism, which prints the weight, the time also being indicated. The device is arranged to weigh a bale about every 20 seconds. The scale platform is enclosed to prevent outside light variations from affecting the electric eye.

Use of Alum in Sludge Drying at Aurora

(Continued from page 28)

whereas the alum-sludge has a rough, lumpy, bubbly surface. This rough lumpy surface is due to the thickening of the sludge floating to the top and to the large number of small surface bubbles resulting from the rapid release of carbon dioxide. The addition of alum appears to materially reduce the CO_2 solubility in the sludge-water mixture, thus releasing the CO_2. The quick "breaking" effect of the alum on the sludge gel was markedly noticeable in the rapid separation of the sludge and water as the mixture flowed across the bed. The maximum dewatering effect of alum was observed to occur during the first 24 hours.

Rain-proof Sludge Beds.—Adjacent beds of treated and untreated sludge proved that the drying of alum-sludge was much less affected by rain, the arch-enemy of sludge beds. The alum-sludge allows the water to pass through it readily. To cite one example of several observed, a bed of untreated sludge was drawn on the third of November. On the 8th alum-sludge was drawn to an adjacent bed; 0.55 inches of rain then promptly fell on the 10th. By the 12th the alum-sludge bed surface was completely dry, whereas the bed of untreated sludge contained a large pool of water. This rain-shedding characteristic of alum-sludge provides a decided drying advantage during the wet winter and spring months.

Dollars and Cents—The Pay-Off.—At Aurora the use of alum has proved economically justifiable, especially during the winter months. The two winters before alum was used, sludge bed cleaning required 27 days at a cost of $873 the first winter and 20 days at a cost of $889 the second winter. During last winter, alum was used and the cost of sludge bed cleaning dropped to $807. This lower cost was due mainly to the easier handling of the frozen alum-sludge cake, the cake being much thinner than that of untreated sludge because of its lower moisture content. During the last winter, the average sludge cake thickness was 4 inches, in other years it has averaged 8 inches and more.

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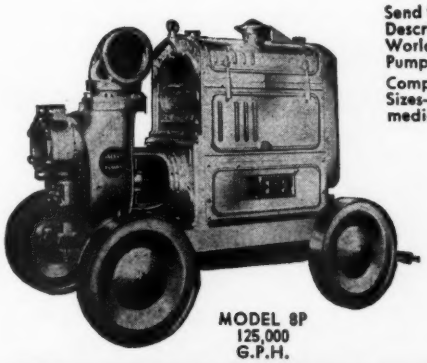

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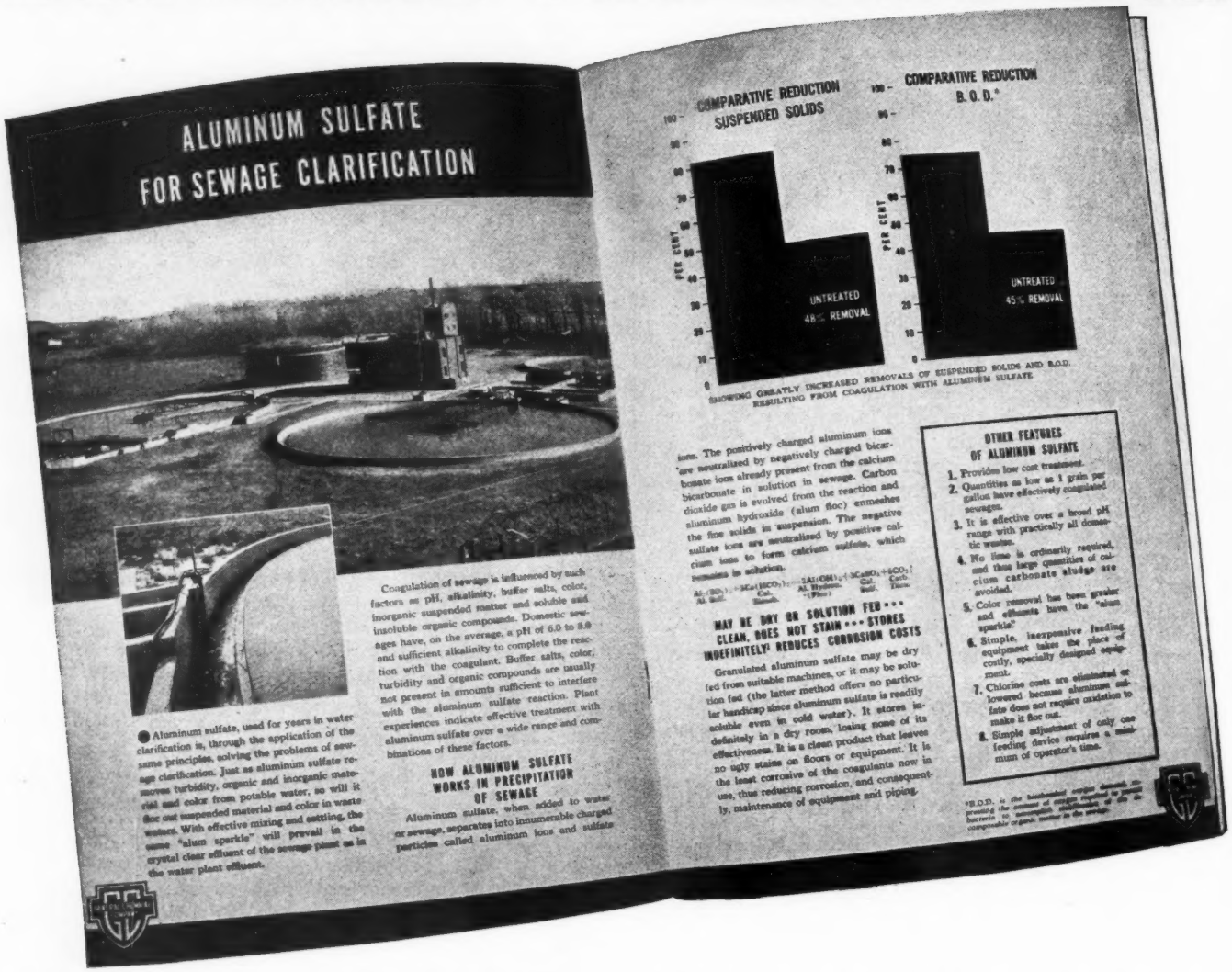
ALUMINUM SULFATE
FOR SEWAGE CLARIFICATION
COMPARATIVE REDUCTION
SUSPENDED SOLIDS
PER CENT
UNTREATED
48% REMOVAL
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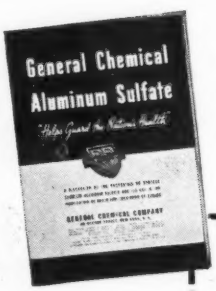
SHOWING GREATLY INCREASED REMOVALS OF SUSPENDED SOLIDS AND B.O.D. RESULTING FROM COAGULATION WITH ALUMINUM SULFATE
Aluminum sulfate, used for years in water clarification is, through the application of the same principles, solving the problems of sewage clarification. Just as aluminum sulfate removes turbidity, organic and inorganic material and color from potable water, so will it floc out suspended material and color in waste waters. With effective mixing and settling, the same "alum sparkle" will prevail in the crystal clear effluent of the sewage plant as in the water plant effluent.
Coagulation of sewage is influenced by such factors as pH, alkalinity, buffer salts, color, inorganic suspended matter and soluble and insoluble organic compounds. Domestic sewages have, on the average, a pH of 6.0 to 8.0 and sufficient alkalinity to complete the reaction with the coagulant. Buffer salts, color, turbidity and organic compounds are usually not present in amounts sufficient to interfere with the aluminum sulfate reaction. Plant experiences indicate effective treatment with aluminum sulfate over a wide range and combinations of these factors.
HOW ALUMINUM SULFATE WORKS IN PRECIPITATION OF SEWAGE
Aluminum sulfate, when added to water or sewage, separates into innumerable charged particles called aluminum ions and sulfate ions. The positively charged aluminum ions are neutralized by negatively charged bicarbonate ions already present from the calcium bicarbonate in solution in sewage. Carbon dioxide gas is evolved from the reaction and aluminum hydroxide (alum floc) enmeshes the fine solids in suspension. The negative sulfate ions are neutralized by positive calcium ions to form calcium sulfate, which remains in solution.
MAY BE DRY OR SOLUTION FED ••• CLEAN, DOES NOT STAIN ••• STORES INDEFINITELY! REDUCES CORROSION COSTS
Granulated aluminum sulfate may be dry fed from suitable machines, or it may be solution fed (the latter method offers no particular handicap since aluminum sulfate is readily soluble even in cold water). It stores indefinitely in a dry room, losing none of its effectiveness. It is a clean product that leaves no ugly stains on floors or equipment. It is the least corrosive of the coagulants now in use, thus reducing corrosion, and consequently, maintenance of equipment and piping.
OTHER FEATURES OF ALUMINUM SULFATE
1. Provides low cost treatment.
2. Quantities as low as 1 grain per gallon have effectively coagulated sewages.
3. It is effective over a broad pH range with practically all domestic wastes.
4. No lime is ordinarily required, and thus large quantities of calcium carbonate sludge are avoided.
5. Color removal has been greater and effluents have the "alum sparkle."
6. Simple, inexpensive feeding equipment takes the place of costly, specially designed equipment.
7. Chlorine costs are eliminated or lowered because aluminum sulfate does not require oxidation to make it floc out.
8. Simple adjustment of only one feeding device requires a minimum of operator's time.
*B.O.D. is the biochemical oxygen demand, expressing the amount of oxygen required to permit bacteria to accomplish stabilization of the decomposable organic matter in the sewage.

••• CONCERNING THE USE OF ALUMINUM SULFATE FOR WATER PURIFICATION AND SEWAGE TREATMENT •••

LAST CALL!



There are only a few of these informative pamphlets still available for distribution . . . and any one who is concerned with this subject should read this pertinent discussion of water and sewage treatment.

The pamphlet is a clear and concise discourse on the properties of Aluminum Sulfate and its use. Such topics as removal of tastes and odors, how aluminum sulfate works in precipitation, methods of application, clarification of industrial wastes, advantages of sludge drying with aluminum sulfate and a number of other important phases of water and sewage treatment are fully discussed.

Particular care was taken in the preparation of this material to insure that the layman would find the pamphlet interesting and understandable . . . at the same time, however, all the material is of a nature that the technical man, in reading it, will find informatively worth while. Just fill out and send in the coupon—there is no obligation.

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Gentlemen: Kindly send me your new pamphlet on the use of aluminum sulfate in water and sewage treatment.

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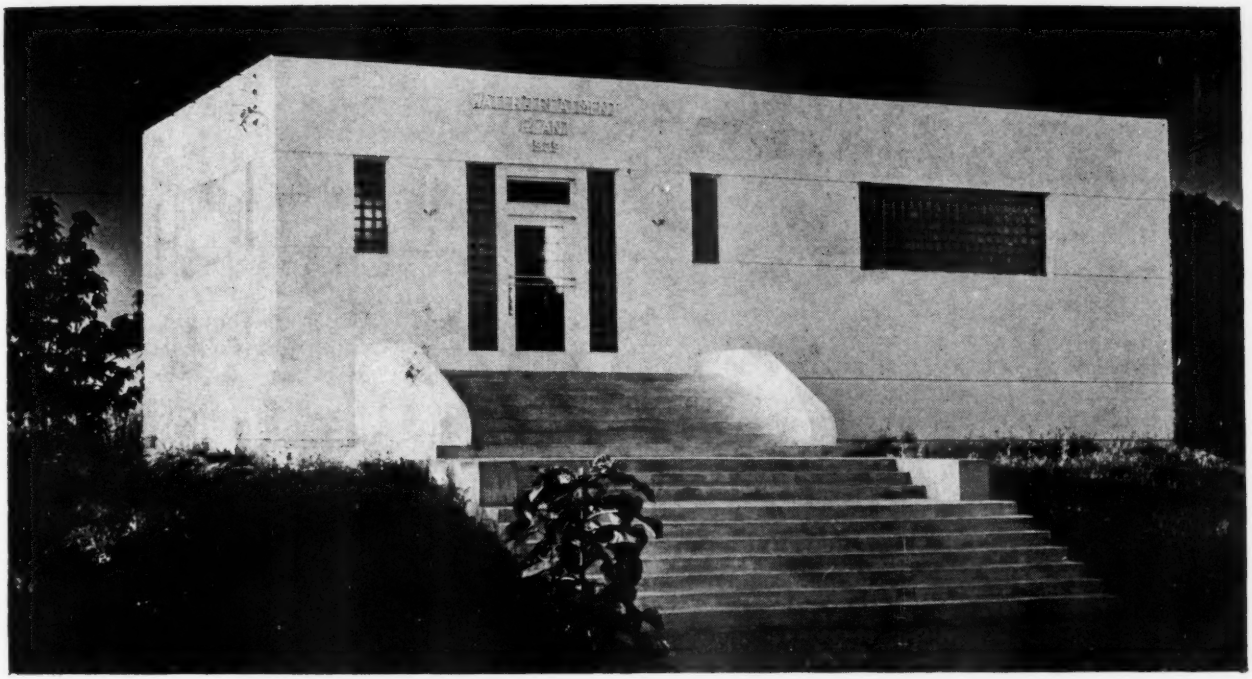


The water treatment plant of Forest, O., is housed in this building.

ABC of Taste and Odor Control With Activated Carbon

By E. A. SIGWORTH
Industrial Chemical Sales Division, West Virginia Pulp and Paper Company

ACTIVATED carbon, as most frequently employed for water treatment, is an extremely fine black powder, resembling in appearance that of powdered coal or powdered charcoal. An activated carbon cannot be distinguished from an unactivated carbon by looking at it.

Carbon is activated by a special treatment, usually involving high temperatures in the presence of activating gases, in order to give it the power to remove impurities from solutions. Some impurities are held on the internal and external surfaces of the carbon particles and the activation procedure may therefore be considered as a cleansing of the carbon surfaces to enable most complete adsorption of impurities in the water to take place. It is therefore easy to understand that a visual examination or even a chemical analysis of a carbon may give no true indication of its value as to activity, which may be described as a quality of carbon which will remove from solution such impurities as odors, tastes, colors, etc. Some physical tests have been developed for activated carbon which are helpful to some extent in the physical handling of the material, as well as in judging the efficiency of the material in actual water plant practice. However, as applied to water purification, the final analysis must be on the basis of what the carbon will accomplish in removal of odors.

Activated carbons can be made for specific purposes, depending upon the raw materials employed and the methods of activation. Many qualities of activated carbon are being offered in commercial fields, but there are relatively few qualities offered specifically for water purification. We know from experiences in industrial applications that a quality of carbon manufactured specifically for treating vegetable oils is not suitable for treatment of sugar solutions and vice versa. In fact, there are frequent references in the literature to the selective nature of activated carbon. Ability of a carbon to remove one compound can not be expected to indicate its value for the removal of another material. It is for this reason that the only true method of evaluating activated carbon is by means of tests on the water on which it is used and the only method available at the present time for making such comparisons is the Threshold Odor Test.

When powdered activated carbon was first considered for correction of tastes and odors in water supplies, a number of difficulties were predicted; for example, passing of the carbon particles through the filters into the distribution system, clogging of the filters, etc. In spite of these considerations, George R. Spalding of the Hackensack Water Company, New Milford, New Jersey, had the courage, after a series of laboratory tests, to try out powdered activated carbon on a plant scale. His experiences in the spring of 1930 were so successful that many others began using powdered activated carbon in their plants for removal of tastes and odors, and with such success that the best available records indicate that 1185 water plants are now using powdered activated carbon for that purpose.

These users are widely scattered throughout the country so that it is reasonable to assume that there are very few, if any, tastes and odors existing in

water supplies that have not at one time or another been successfully eliminated with activated carbon. In this connection, John R. Baylis* has stated "all tastes and odors likely to be present in a water supply can be removed with activated carbon. . . . We find a few statements in the literature on water treatment that the taste or odor was not removed by the addition of carbon, but almost invariably the reason was that not enough carbon was used."

How Activated Carbon Works

Activated carbons purify water by adsorption, which is a physical reaction rather than a chemical reaction; the odorous compounds are not changed but are actually removed from the solution. Physical adsorption differs from a chemical reaction in that doubling the quantity of carbon will not result in doubling the removal of impurities. Consequently if the odor in the water suddenly becomes double, it is necessary to use more than twice as much activated carbon in order to deliver a water having the same palatability. Stating this in another way, 5 parts per million of activated carbon may remove 50% of an odor from water, whereas the use of double the quantity or 10 parts per million may accomplish only 75% removal. This actually means that the last traces of odor are more difficult to remove and will require increasing amounts of activated carbon.

In the small plants the cost of activated carbon over a period of a year may be only $100 to $500, and usually in such cases any savings possible through evaluation of the various carbons available would be relatively minor. Under such circumstances, it is best for water plant officials to continue to use that activated carbon which has proven successful in their plants.

Carbon Dosages for Taste and Odor Control

The proportion of carbon necessary for control of tastes and odors will depend upon the types of odors to be removed as well as their intensity and no definite dosages can be recommended for the conditions likely to arise in all water supplies. In general, it may be stated that under average conditions 20 to 40 lbs. of activated carbon per million gallons of water will be sufficient to secure a palatable water. Where odors are quite intense or of a type difficult to remove, considerably higher proportions are necessary, ranging perhaps from 100 to 500 lbs. per million gallons. In some rare cases it has been necessary to employ as high as 1500 lbs. per million gallons for short periods of time.

In order to determine the proper dosage of carbon to employ under an unknown condition, tests can be carried on in the laboratory employing varying dosages. Dosages will have to be determined by trial and error and as a start it is suggested that four tests be made, using dosages ranging from 20 lbs. per million gallons to 100 or 200 lbs. per million gallons. When the two optimum dosages have been learned, intermediate dosages can be employed in order to determine more accurately the dosage optimum for delivering a palatable water. Detailed methods for determining the carbon dosage have already been published in a booklet entitled "Taste and Odor Control with Activated Carbon." Two methods are described, one where laboratory facilities are available and the other where laboratory facilities are not available. Copies of this booklet can be obtained by writing to "Public Works Magazine."

*John R. Baylis, Elimination of Taste and Odor in Water, McGraw-Hill Book Co.—1935.

Application of Activated Carbon

In order for activated carbon to remove tastes and odors from a water supply, it is necessary that the carbon particle be completely wet with water so that the whole surface has an opportunity to come into contact with the materials to be removed. It is also desirable for economic reasons that the dosage be no greater than is necessary to deliver a palatable water. Thus, the primary factors involved in the method of application are: First, that the carbon be thoroughly wet with water; and, second, that the feeding equipment should proportion the dosage fairly accurately and be capable of adjustment for meeting varying conditions of taste and odor intensity.

Activated carbon may be applied by either solution feed or dry feed methods, but in either case certain precautions should be taken, since this material differs from usual water works chemicals.

If the solution method of feeding is adopted, it must be borne in mind that activated carbon is not soluble and therefore has a tendency to settle out of the suspension. Therefore, some means of agitation must be provided to insure a constant concentration of carbon. If orifices are used for proportioning the feed, they should be examined periodically, particularly if small, and should be calibrated at intervals.

Where dry feeding equipment is employed, difficulty is occasionally encountered with activated carbon bridging in the feeding hopper, so that hoppers should be equipped with suitable agitation or mixing devices. Slopes of the sides of the feeding hopper should be as steep as possible and in fact it is suggested that at least one side of the hopper should be vertical. The solution chamber into which the dry carbon drops should be so designed that the carbon particles will be thoroughly wet by the water; unless sufficient agitation is secured in the solution chamber some of the carbon may not be completely wet and as a result will float on the surface of the water, remaining relatively ineffective for taste and odor removal.

Where funds are not available for purchase of standard feeding equipment, some water plant operators have used their ingenuity to prepare home-made feeding equipment. Such equipment has been described in literature from time to time and has been reported to work fairly successfully. However, such pieces of equipment are frequently inaccurate and quite troublesome, involving considerable time on the part of the operator to keep the equipment functioning properly. Therefore, wherever possible it is suggested that standard equipment furnished by reputable manufacturers be employed for activated carbon application.

Point of Application

The carbon suspension from the feeding equipment should be delivered to the water at a point such that all the carbon will be removed before the water is delivered to the distribution system. Usually this involves application of the carbon prior to sand filters. However, carbon has been applied with entirely satisfactory results in water systems where filters are not available. For example, Wm. T. Bailey of Council Bluffs, Ia., has been applying activated carbon in his water plant for a period of seven years and depends solely on coagulation and sedimentation for the removal of carbon particles. In other cases, carbon has been applied to reservoir supplies, where the reservoirs are taken out of service for a period of 24 hours to five or six days in order to allow the carbon to settle to the bottom.

In water plants where filters are available, carbon may be applied to the water at any point prior to filtration. Carbon has been applied: 1. To the raw water; 2, to the mixing chamber; 3, to the settling basins; 4, to the filter influent; and, 5, directly on top of the filters. Also, in some plants a split method of feeding is adopted, particularly at certain periods of the year. (In the split method the carbon is applied at two different points, for example, to the raw water and to the filter influent.)

It must be realized that conditions vary in different plants, and the proper point of application is a problem to be considered individually for each plant in order that the maximum results be secured.

In considering the point of carbon application, certain basic conditions should be taken into consideration. First, since the quantity of water carrying carbon from the dry feed machine is only a fraction of the total quantity of water to be treated, it is important that the carbon suspension be delivered at a point where the carbon will disperse quite readily throughout the entire body of water to be treated, for the carbon particles must come in fairly intimate contact with the taste and odor bodies in order to accomplish their removal. It can be realized that if the carbon is applied at some quiescent point in the settling basin, some of the water at the edge of the basin will not be reached by it.

Second, since taste and odor removal with activated carbon depends upon the carbon particles getting in contact with all the odor-causing impurities, the longer the carbon is in suspension in the water, the greater is the opportunity for odor removal. From this point of view it would be desirable to apply the carbon to the raw water or the mixing basin.

Third, types and intensities of odor in water supplies will vary sometimes in a very short period of time, and an objectionable odor may pass through into the distribution system before the operator realizes that a change has occurred. Under these conditions it is desirable to apply the carbon immediately and get the water treated as quickly as possible, which is best effected by applying it directly to the filters or to the filter influent.

When activated carbon is properly stored it will retain its ability to remove tastes and odors from water supplies for long periods of time. However care should be exercised in preventing, insofar as possible, contamination by odors in the atmosphere, chlorine and other gases, and oily or tarry substances. Also carbon should be stored under relatively dry conditions; moisture will not adversely affect the activity of carbon, but in sufficient amounts it will cause feeding difficulties, particularly when dry-feed machines are employed.

Importance of Taste and Odor Removal

It is realized that consumers of today are much more critical of the taste and odor of a water supply than they were 10 or 20 years ago. This may be due in some part to the successful efforts of many food manufacturing concerns to improve on the palatability of their products. Such improvements have resulted in increased sensitivity of various individuals for foreign tastes and odors in food and it is quite natural that consumer attention should be directed to the palatability of water also.

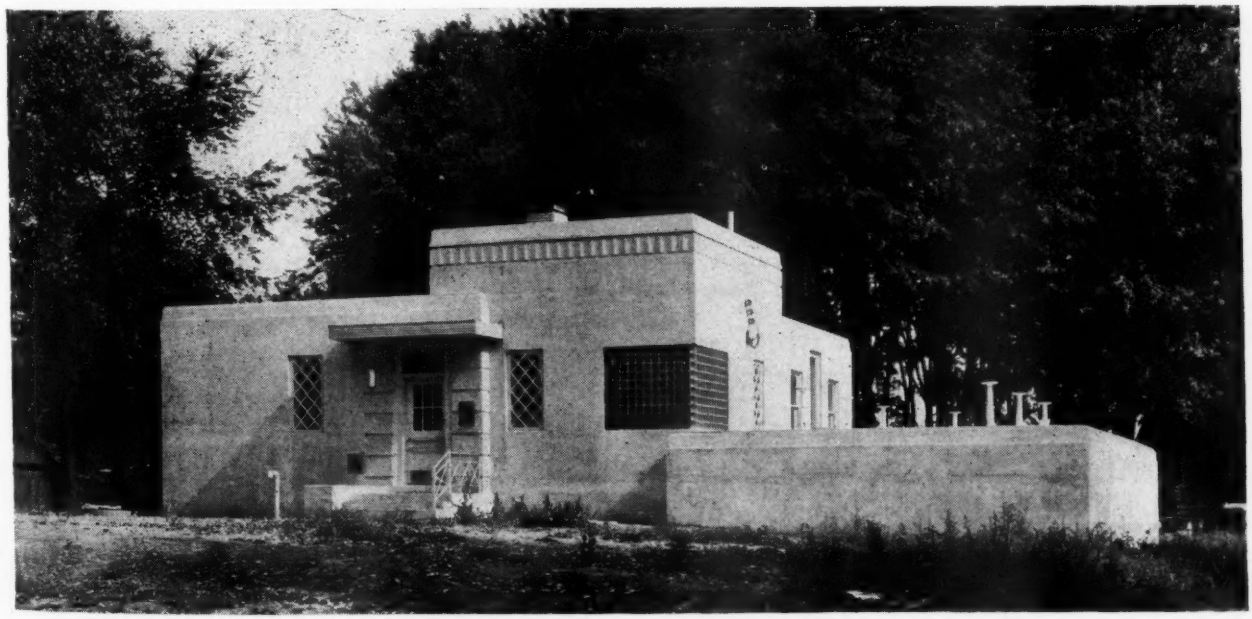
Many waterworks men realize that it is essential to deliver a palatable water to consumers as protection to the health of the community. Delivery of a palatable water at the taps of a community insures against the desire of individuals to use another water which may be more agreeable but perhaps unsafe for human consumption. Consequently, activated carbon plays its part in protecting the health of a community.

Types of Tastes and Odors

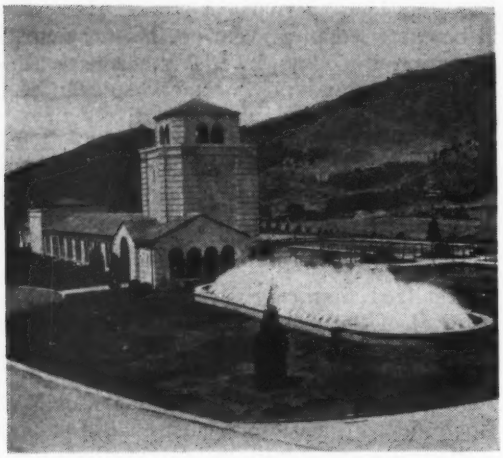
When an individual reports that water has a bad taste, he usually means that it has an objectionable odor. It has been stated that psychologists have apparently recognized only four taste sensations; namely, salt, sweet, sour, and bitter. Consequently, it should be realized that in water supplies we are dealing principally with odors and not tastes.

Odor in a water supply may be described differently by various individuals, depending upon their personal sensitivity and experience. Herewith is a list of odors most frequently encountered in water supplies:

Aldehol	Grassy	Phenolic
Algae	Hydrocarbon	Pig Pen
Aromatic	Hydrogen Sulphide	Ripe Cucumber
Chlorophenol	Marshy	Rivery
Cod Liver Oil	Medicinal	Septic



The filter plant building at Frankenmuth, Mich.



Upper San Leandro filter plant, Oakland, Calif.

Cooking Corn	Melting Ice	Sewage
Creosote	Moldy	Stagnant
Disagreeable	Muddy	Swampy
Earthy	Musty	Sweetish
Fishy	Muskmelon	Tarry
Free Chlorine	Nasturtium	Vegetable
Gasoline	Oily	Woody
Geranium	Peaty	Violets

Any of these odors may appear in water supplies either alone or in various combinations and in varying concentrations.

Causes of Odors

Odors in a water supply may originate from algae, decomposing leaves, decaying vegetation, trade waste, sewage, and a few other minor sources. The most frequent cause of odor in water supplies is due to various types of algae growths. Although there are an extremely large number of different types of algae, only about 25 or 30 types are recognized as causing an objectionable odor in a water supply. Some of the most frequent algae types causing odors in a water supply are as follows:

Anabaena	Crenothrix	Synura
Aphanizomenon	Dinobryon	Uroglena
Asterionella	Synedra	Volvox

Second in importance as a cause of odors is decaying vegetation on the shores and bed of the streams, lakes, reservoirs, etc., but especially in swampy and stagnant areas. Decomposing sludge in the settling basin of the filter plant itself can also be considered under this classification.

Wastes from industrial plants and sewage plants may be a very troublesome source of odors in a water supply. Fortunately, water pollution of this nature is relatively infrequent, but when it does occur the odors are usually quite severe. Some industrial wastes that result in an objectionable odor in a water supply, are: Beet sugar plants, canneries, tanneries, oil refineries, steel mills, and chemical plants. In general, odors from such sources are somewhat difficult to remove, necessitating somewhat higher proportions of activated carbon in order to deliver a palatable water.

Measuring Odor Intensities

When powdered activated carbon was first used in water teatment, it was difficult to determine by any scientific means exactly what results were being secured. However, as its use was extended to many plants and as other qualities of activated carbon were being offered for water purification purposes, it became increasingly important that some means be available for measuring odor intensities. Charles Spaulding, Springfield, Ill., is responsible for giving to the water works profession the "threshold odor" method of measuring odors. Considerable research and developmental work has been done to improve the efficiency and accuracy of this testing method and at the present time the threshold odor test is recognized by the Activated Carbon Research Committee, Water Purification Division of the American Water Works Association, and other leading water works authorities, as the most successful means of determining intensity of odors in a water supply.

Threshold odor values represent a direct measure of the amount of odor in water. For example, a threshold odor of zero means complete absence of odor. A threshold odor of 20 is twice as strong as a threshold odor of 10, and a threshold odor of 100 has twice the intensity of that of a threshold odor of 50.

The threshold odor test depends upon the sense of smell of the operator carrying on the test. Since the sense of smell will vary quite appreciably among different individuals as well as at different times for the same individual, it must be realized that care should be taken in interpretation of threshold odor values. Where direct comparisons are to be made on threshold odor values, the work should, insofar as possible, be carried on by one individual and within a short period of time, so that the individual's sensitivity does not have an opportunity to change.

Method of Determining Threshold Odors

The basis for determining threshold odors is comparison against a standard of odor-free water. There are a number of ways whereby odor-free water may be obtained, but since considerable quantities are necessary, the most desirable method of preparation is to pass tap water through a column of granular activated carbon at a slow rate so that sufficient contact with the water is secured. The sample of water to be tested is mixed in definite proportions with odor-free water and the odor of the sample compared with that of the odor-free water. The usual procedure is to determine hot odor, and the odor-free water, together with the mixture of the sample with odor-free water, are heated to a temperature of about 60° C. or 140° F. If accurate results are to be secured, it is important that all of the samples be examined for odor while they are at the same temperatures. In testing for odors, the flasks are shaken in order to liberate the odor and then smelled to determine whether an odor can be discovered in one of the flasks. It is recommended that the observer be able to describe the characteristic odor at the time of the tests. If no odor is noted in either of the samples, then it is necessary to use a larger proportion of the sample of water that is being tested. On the other hand, if an odor is detected in the sample being tested, then another test is carried on using a lower proportion of the sample blended with the odor-free water. By carrying on sufficient trials, the point is reached where in one case the odor is just detectable and in the next lower concentration, the odor is not detectable. That dilution, at which the odor is just detectable, is considered as the end point of the test. The amount of the water being tested that is in the sample, divided into the total amount of water employed is the threshold odor number of the water for the individual observer.

Carrying on the threshold odor test dilutions in a systematic manner will decrease considerably the number of tests necessary, and naturally will reduce the amount of time involved. Such a system is de-

scribed in a laboratory wall chart entitled "A Method for Measuring Tastes and Odors in Raw and Tap Water," obtainable through "Public Works Magazine." This wall chart also contains a table so that the threshold odor numbers can be read off directly after the test is completed. Testing procedure and apparatus necessary for the threshold odor test are also listed on this chart.

Use of the Threshold Odor Test

The most important use for the threshold odor test is insuring the delivery of a palatable water to the consumers at all times. This can be accomplished by running periodic threshold odor tests on the tap water in order to determine if treatment is necessary to secure this. There is some difference of opinion as to the threshold number of a water which will be considered as palatable. Some water works authorities have suggested that threshold odors of 2 or 3 should constitute a palatable water; others have maintained that a water having a threshold odor of 10, 20 and sometimes higher can still be classified as a palatable water. There is undoubtedly some justification for these differences of opinion. In the first place, certain types of odors are more unpleasant than others, in which cases it would be desirable to keep the threshold odor number as low as possible in order to obviate complaints from consumers. Other types of odors might be somewhat mild and unobjectionable except in fairly concentrated conditions, so that water having somewhat higher threshold odor numbers could be delivered to the consumer without objection.

Secondly, an individual can become so accustomed to a certain type of odor that it is no longer objectionable to him. This is perhaps one of the reasons that certain water works operators can deliver a water having a relatively high threshold odor, without receiving consumer complaints. However, if the *type* of odor were to change suddenly, without any change in odor intensity, it is quite probable that a flood of complaints would be received. An excellent way for a water plant operator or superintendent to get an unbiased opinion of the palatability of his water is to visit hotels and restaurants. Visitors to a community will be the first to notice any odor in a water supply, so that a business catering to transient trade will be the first to receive complaints on the palatability of the water.

A third reason for the difference of opinion previously mentioned is that the sense of smell is more acute in some individuals than in others. Consequently, if the individual running the threshold odor test has an extremely keen sense of smell, it is quite possible that a water can be delivered having, to him, a somewhat higher threshold odor value without receiving complaints, particularly if the residents of the community have only average sensitivity. On the other hand, if the individual running threshold odor tests in the plant has relatively poor sensitivity for odors, it may be necessary for him to turn out a water having threshold odors as low as 2 or 1, in order to eliminate complaints, particularly if some of his consumers are extremely sensitive to odors. The opinion of transients is a good means of checking the sensitivity of the individual running threshold odor tests.

Therefore it is difficult to lay down any stated hard and fast rule for the threshold number of a water that will be considered as palatable. It is suggested that the water plant operator deliver a water having a threshold number varying from 3 to 5 as a start and then be governed by consumer opinion.

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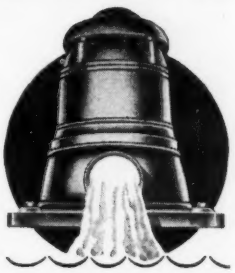

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Another use for the threshold odor test is to determine the efficiency of the plant, as well as of the various chemicals employed, for eliminating odors from the water supply. For example, the efficiency of aeration, coagulation and filtration for odor removal can be determined by means of the threshold odor test. All that is necessary is to test samples before and after such treatments. Efficiency will necessarily vary from time to time depending upon types of odors present in the water, temperatures, etc., so that if complete data are desired it will be necessary to carry on tests periodically.

The threshold odor test can be used to determine the point at which to apply activated carbon in order to secure maximum removal of tastes and odors with a minimum quantity of carbon. Periodic threshold odor tests should be run on raw and finished water during the period when the point of carbon application is being changed. Care should be taken in drawing conclusions from work of this nature, giving particular attention to types of odors as well as intensity of odors.

Some types of odor are not necessarily adsorbed as readily as others, so that it is desirable that any comparison be made on the same type of odor. As already explained, it is more difficult to remove small traces of odors from water, therefore comparisons should be based insofar as possible on periods of time when odor concentrations in the raw water are the same.

Another use for the threshold odor test is evaluation of activated carbons in order to determine the carbon that will most economically remove tastes and odors from an individual water supply. Where such use of the threshold odor test is contemplated, it is essential that extreme accuracy be secured in running the threshold odor test. It is therefore suggested that those interested in the use of the threshold odor test for this purpose, obtain full information on procedures and develop some experience in making the test.

Summary

The statement that an ounce of prevention is worth a pound of cure can be applied in some instances to odors in water supplies, and water works officials should investigate the possibility of preventing contamination at the source. For details in this connection, it is suggested that the reader refer to an article by the writer "Basic Principles of Taste and Odor Control" which appeared in the April, 1937, issue of "Public Works Magazine." If it is not economically or practically possible to prevent odors in a water supply, it is necessary that some means of treatment be adopted to correct the condition, and activated carbon has been universally accepted as the means of removing tastes and odors, regardless of type.

Activated carbon will successfully remove tastes and odors which may be encountered in a water supply. Delivery of a palatable water to consumers at all times is most important, since it eliminates the desire of consumers to use a more palatable, but perhaps less safe, water supply. Norman J. Howard states: "Under normal operating conditions, carbon costs approximately $1.25 per million gallons."

The threshold odor test is a valuable means of determining the dosage and proper point of application for activated carbon, and controlling delivery of a palatable water to the consumers at all times. Since different activated carbons do not adsorb different compounds to the same degree, the most logical means of evaluation of them is on the water to be treated, utilizing the threshold odor test method.

Chemical Treatment for the Control of Algae and Weeds

The control of algae and of rooted weeds are two separate problems and involve the use of two different chemicals. Copper sulphate is used to control algae. The chemical is applied at the time the algae start to grow, so as to prevent their development in excessive numbers. Several applications are made during the season. Little is gained by treating at the time the bloom is at its height because the algae, though killed, would be washed ashore, decompose and cause an offensive odor. However, if growth and reproduction can be arrested, the nuisance is prevented.

The elimination of rooted weeds involves the use of sodium arsenate which is a more dangerous chemical. Arsenical compounds are considered as poisons. A dilute solution is sprayed on the surface of the water over the plants. Arsenic is absorbed through the leaves and carried to the roots which then kills the plant. This treatment is permanent until the area is reseeded. The experiments showed that fish (bluegills) can live at least six days in a solution that contains sufficient arsenic to kill plants. Further research showed that large mouth bass survived 232 hours in 6 p.p.m. solution. 87% survival was had in a 10 p.p.m. solution. Crappies and bluegills were unable to stand a 15 p.p.m. solution of arsenic.

A summary of a progress report of the Wisconsin State Committee on Water Pollution, which pertains to the control of algae and weeds contains the following data on experimental results:

1. The toxic doses of copper sulphate recorded in the literature for the various species of fish are correct only for distilled or very soft waters.
2. The mineral salts of hard waters remove copper from solution as an insoluble precipitate, thus increasing the amount of chemical which may be added before fish are killed.
3. The fatal dose for young large mouth black bass in hard water is 80 p.p.m.; for larger bass is about 160 p.p.m.
4. Very short exposures of fish to high concentrations of copper sulphate produce high mortality.
5. Sodium arsenite acts very slowly upon fish and has no toxic effect until the dosage approaches 10 p.p.m.

The lethal effect of copper sulphate on fish apparently is a purely mechanical action; the copper sulphate combines with the mucin on the gills and forms an insoluble, impermeable membrane upon the gill surface. This results in rapid suffocation of the fish. Sodium arsenate, on the other hand, is a true poison and owes its toxic action to chemical interferences with body functions after it has been absorbed into the system.

The committee states it is not prepared to give figures on the actual or total cost of treatment. Many factors must be taken into consideration. For example, the species of algae to be controlled determines the amount of copper sulphate necessary. Roughly, one-half to one and a half pounds per million gallons is sufficient to kill the undesirable forms. This chemical can be purchased for 4.5 cents per pound, or from 2.5 to 7.5 cents per million gallons of water treated. Assuming a treatment every two weeks during the summer, a minimum of eight treatments would be necessary. The cost of chemicals per season would then range from twenty to sixty cents per million gallons of water treated. These costs do not include equipment and personnel.

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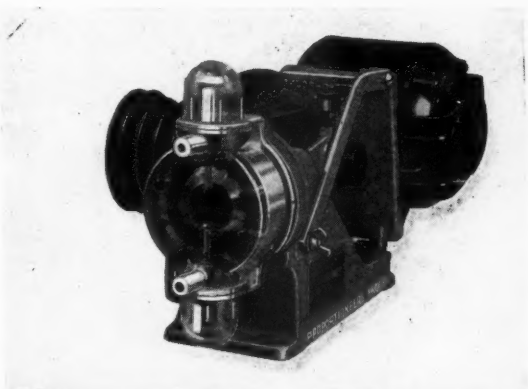

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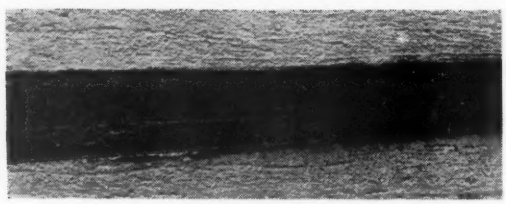

Close-up of finished line

Permanent Traffic Lines for Concrete Pavement

By B. G. KESTING
County Engineer, Lucas County, Ohio

IN ORDER to avoid the recurrent expense of painting traffic lines on pavements, it was decided to investigate the various methods of placing permanent traffic lines. Deputy County Engineer Melvin Rice, who made this study, found that the Texas State Highway Department had a specification which appeared to meet our requirements. This procedure is covered by the French patent and makes use of black magnetic iron oxide for coloring the stripe.

We were anxious to incorporate this center marker in our concrete pavement, of which, during 1939, we laid some 62,000 sq. yd. Most of the pavement was 20 ft. wide, though some was 36 ft. wide. All needed center striping.

We adopted the Texas specification with respect to material and color desired. This is: "Coloring material to be used shall be magnetic oxide of iron, or ferrosoferric oxide, made by a process of chemical precipitation so as to form a pigment of uniformly small particle size." The standard of color comparison is a commercial product known as "Raven Black."*

The next problem was to construct a bridge from which the center striping could be placed without injuring the newly placed concrete. This bridge was designed in the county engineering department, and was built by maintenance forces when work was slack. Except for the wheels, the structure was built of salvaged materials. The wheels cost $35 and only 45 man-hours of labor were required to build it. It is made of steel I-beams mounted on wheels running on the side forms and stiffened laterally with small angles. From the center of the bridge are suspended two steel channels equidistant from the road centerline. To the bottom legs of the channels are fastened two angles to give the channels a cutting edge. The channels were placed with a 6-in. clear space between webs.

When the bridge is in operation, the angle legs rest lightly on the fresh concrete, providing a 6-in. strip into which iron oxide is applied. This whole assembly may be raised or lowered by manually operated screws.

Iron oxide is blown onto the concrete with a lime duster, thus permitting even distribution. It is then worked into the concrete with a wooden float and finally with a steel float to obtain an even surface. Investigations show that the concrete is penetrated to a depth of ⅛ to ¼ in.

The iron oxide is applied at the rate of 2½ lb. per 100 ft. of 6-in. marker width. It costs 8½ cents a lb., or 21¼ cents per 100 lin. ft.

The striping requires the full-time services of one man and part time of a second. The second man is needed when the bridge was moved ahead.

Labor costs were difficult to keep, due to the varying lengths of pavement placed each day. Assuming, however, that 100 lin. ft. of traffic marker can be placed each hour and that $1 is a reasonable rate for the full-time man and 25 cents an hour for the part-time worker, the cost of the striping, excluding the cost of the machine, is only $77.22 a mile. It can be reasonably assumed that under normal operations the per-mile cost of striping would be much under $100, even including depreciation and maintenance of equipment.

While there was some doubt as to how this centerline would stand up through the winter, careful inspections made this past spring indicated there had been no deterioration at all and the line appears to be in the same condition that it was immediately after installation. This year's program includes about 13½ miles of concrete pavement, on which the same kind of centerline will be used.

*Manufactured by the George S. Mepham Co., East St. Louis, Ill.

Surface Regularity in Bituminous Surfacings

While a regular surface is relatively easily provided at the time of construction, the preservation of regularity depends not only on the composition and finish of the surfacing, but also on its thickness, on the uniformity of its structure, and on the provision of a properly shaped and consolidated foundation. A possible cause of local subsidence is the progressive consolidation of material replaced in excavations after repairs to underground mains, etc. Such material should be carefully consolidated mechanically, and in small excavations it may advantageously be covered with a thin course of lean concrete. If an existing surfacing is to serve as foundation, all holes and irregularities must be filled with bituminous material. If this consists of mastic asphalt the holes should be cleaned out, painted with bituminous material and filled with the mixture, after which construction may proceed at once; precoated chippings require some weeks of consolidation under traffic before the surfacing is applied. Uniform consolidation of the latter depends on the effective distribution of the material, both the thickness and the composition of which should be uniform over the whole surface of the carriageway.

On small jobs, especially in urban work, consolidation must usually be done by rolling, and it is recommended that after the initial longitudinal rolling the roller should be worked in two series of semi-circular traverses, one from each side of the road. Lack of uniformity in the mixture often results in defects which develop progressively under traffic. This is especially likely in hot-process surfacings, where only a limited time is available for consolidation before the material cools. Uniform spreading is therefore especially important in hot-process work. Large quantities of the mixture should not be tipped on to the foundation before spreading, as this procedure results in uneven thickness and frequently in segregation. Before the material is struck off it should be thoroughly raked by experienced workmen, who can recognize local excess of binder or the presence of overheated material, and can interpret the behavior of the mixture while spreading and consolidation are in progress.

Material which is found unsatisfactory during distribution is unlikely to become properly consolidated, since the roller runs on the higher portions only, the lower areas retaining their open structure. An illustrated description is given of defects of this type in a sand-asphalt surfacing, and it is pointed out that correct placing and distribution are especially important in thin carpets, owing to the small amount of material present. Surface irregularity may also be caused by blistering. The author dissents from the view that blisters are caused by moisture derived from concrete foundations. He cites cases of blistering in bituminous surfacings applied to steel structures, in a 1.2-in. wearing course of mastic asphalt placed on the 2-in. binder course, and in a stone-filled mastic asphalt surfacing placed on compressed asphalt. In many cases blistering is first observed some years after construction. It is suggested that blistering is probably due to the composition of the surfacing rather than to the presence of moisture.

The liability of cold-process surfacings to corrugation is relatively slight, since more time is available for consoldation. Low areas should be filled up while rolling is still in progress with material which is tamped by hand and subsequently rolled. The surface finish is improved by consolidation with a heavy rub-

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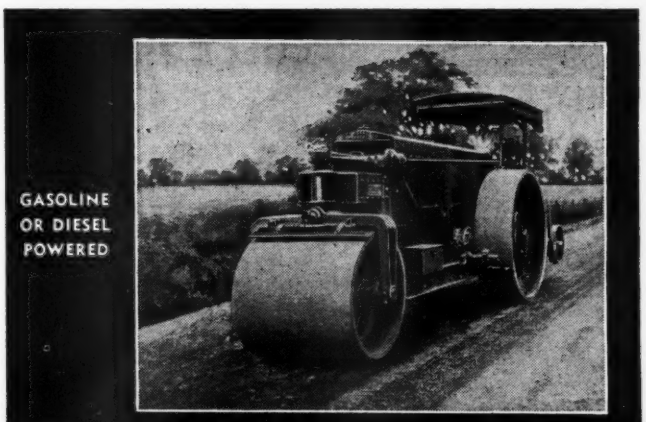

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ber-tired truck, which should be driven over the surfacing shortly before rolling is complete; the kneading action of the tires assists the interlocking of the aggregate. Special attention should be given to drainage in the construction of cold-process surfacings; during the period between consolidation and the application of the sealing coat the removal of surface water should be assisted by removing a sett from the channel every 50 ft. and filling the cavity with broken stone and chippings. In conclusion the author describes a method of checking surface regularity during construction.—By R. P. Marx, Asphalt u. Teer, 1939, 39, 26.—Road Abstracts.

New County Maps Show Full Road and Bridge Detail

County maps showing all highways and all structures in rural areas, will soon be available through State highway departments. Drafting work on sheets covering 2,741 counties—or approximately 90 percent of the counties in the United States—has been completed. These maps are the result of highway planning surveys conducted by the State highway departments in cooperation with the Public Roads Administration. According to the Public Roads Administration, they will soon be completed for all counties in every State and many of the State highway departments already have them available for general use.

The details shown range from the railroads, highways, roads and bridges to the separate dwellings, farm units, stores and industrial plants in the rural areas. Distinction is made between occupied and vacant structures. Streams actually navigable are shown. Also shown are such details as schools, hospitals, churches, cemeteries, camps or lodges, oil and gas wells, mines and quarries, power plants, radio stations and air fields.

These maps are being used by business organizations and government agencies in addition to their use in highway planning. In 29 States they were used by the Census Bureau for laying out the field work of the enumerators employed in the 1940 census and in fixing boundary limits around the settled areas of unincorporated urban communities of 1,000 or more population.

The Public Roads Administration and the State highway departments are making special efforts to keep the maps annually revised and up to date. Since the maps for the entire country show more than 3,000,000 miles of road, and since improvements are made annually on as many as 50,000 miles of road, the revision necessary to keep the maps abreast of road improvements completed is not a simple task.

Topeka, Kans., Airport Is Completed

One of the latest additions to the nation's network of airports and landing fields is the Phillip Ballard Airport at Topeka, Kansas, a 166-acre tract that can be used as an all-way landing area. Built by the Work Projects Administration under the sponsorship of the City of Topeka, the entire field was completed in the summer of 1940 with full facilities for commercial use, and provision for extensions and improvements that might be necessary should the field be needed for military purposes, or to place it in line with requirements for a high rating by the Civil Aeronatics Authority.

In addition to grading and draining the field, WPA crews removed trees and old buildings at the north end of the field and constructed three runways, with 7-inch sledged stone base and a two-inch asphaltic penetration macadam wearing surface. The runways, each 100 feet wide, include a north-south runway 2,570 feet long, a northwest-southeast runway 2,800 feet long, and a northeast-southwest runway 3,770 feet long, with provision for future extension as conditions may require.

In addition to the paved runways there are approximately 530 feet of 50-foot width taxi strip and a large paved apron 180 feet by 125 feet connecting the hangar to the runways. The taxi strips and about half of the apron are paved similarly to the runways, while the remainder of the apron, immediately adjacent to the hangar, is built of concrete.

A system of underground drains has been installed in the runways and the field. This is designed not only to preserve a dry and stable subgrade under the runway paving, but to remove surface drainage and thus eliminate operation hazards due to ponded water or soft soil abutting the runways. These drains of 6-inch tile, flank the runways and other paving at each side and drain into sumps which were carried down into a coarse gravel water-bearing formation.

The hangar storage space is 100 by 120 feet, with a 100-foot door facing the field and a 50-foot door at the rear to permit quick removal of planes in case of fire. In addition, there is a two-story tower on each front corner furnishing office and storage space, as well as rest rooms for pilots. The hangar is built of native stone with a concrete floor and will accommodate 20 of the smaller type planes in common use. A large shop space 25 feet wide runs along the full length of the north side of the hangar.

There are approximately 1,587 linear feet of drives and roadway, about 950 feet of four-foot walk and ample parking space. Landscaping, fencing and improving by bituminous surfacing of the approach to the airport complete the work.

Water System Piping Increased by Migration to Suburbs

The effect of the migration from cities to suburbs is illustrated by recent figures of the American Water Works & Electric Co. which is continuing its interesting reports on its more than 75 water plants. During the 10-year period from 1929 to 1939, the number of customers per mile of main decreased from 77 to 75; in the same period, the number of customers increased by 51,907 to 647,096.

In 1929, there were required for each customer 68.2 ft. of distribution main; in 1939, 70.7 ft. were required, an increase of 2.5 ft. per customer. As a result, an additional 306 miles of main have been needed that would not have been required had the number of customers per mile remained the same.

Controlling Algae by Blackouts

A new principle for controlling algae in settling basins is reported by the *Georgia Faucet*. It is based on the principle that algae will not grow except in the presence of light and the method of control is based on the use of at least 2 ppm. of activated carbon to the water entering the settling basin. The activated carbon shuts out the light and prevents algae growths.

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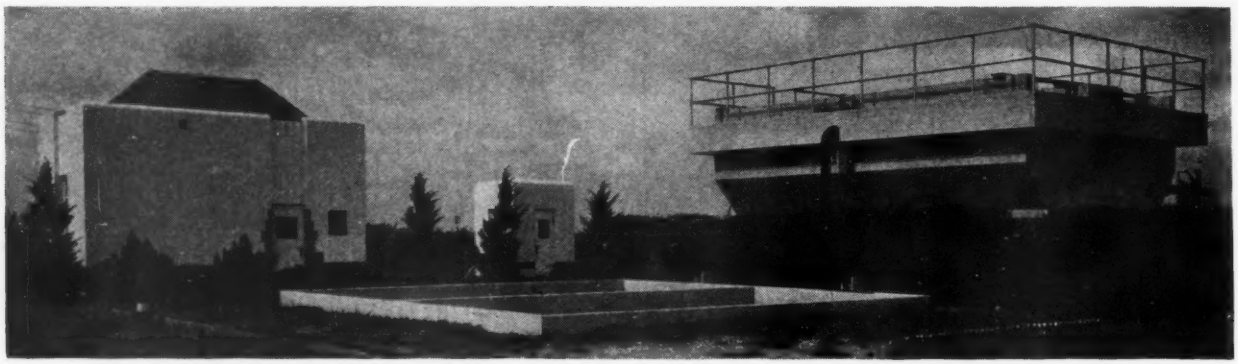

Pump house and laboratory of the Monticello, Ill., sewage treatment plant. Imhoff tank at right.

The Sewerage Digest

Sewage Gas Sold by Albuquerque

Albuquerque, N. M., treats an average of 3.5 mgd of sewage by chemical precipitation (chemicals used only part of the time) and two-stage digestion. The primary digester is heated to 90° to 93°F by gas engine cooling water. The engine is 150 hp and generates current to operate the plant. Surplus gas is sold to the local public utility system, yielding a revenue equivalent to approximately three-fourths of all the plant operation costs. No hydrogen sulphide or ammonia is found in the gas, methane constitutes 68.16% and CO_2 31.65%.[H34]

Sludge Disposal At Cleveland, Ohio

Cleveland's Westerly plant in 1939 filtered 5,758,000 gal. of digested sludge and the Southerly plant 41,236,000 gal.; and 8,550 tons of filter cake were incinerated at the former, 38,850 at the latter. The total solids in the digested sludge is 9.53% at the former and 5.7% at the latter. The sludge at the former is from sewage containing packinghouse wastes settled in Imhoff tanks and digested at 90° F.; while at the Southerly plant the digestion tanks receive excess activated and fresh solids and sludges from several sewages, some with high iron content, digested at 70° to 75° F. Not only do the digested sludges at the two plants differ, but a different type of digestion appears to take place. At the Westerly plant there appears to be more weight of gas formed than of volatile matter destroyed, indicating addition of water by hydrolysis during digestion; while in the Southerly digesters there is a substantial unaccounted for loss, indicating liquefaction during digestion.

While fresh solids furnish more combustibles for incineration than does digested sludge, the latter is better adapted to evenly tempered burning, with less danger from flashes and overheating. About 50 tons of dry sewage solids are filtered and incinerated at Cleveland daily, producing about 25 tons of ash, including chemicals. The total costs (labor, chemicals, power, etc.), per ton of dry filter cake solids are, for conditioning and filtration, $5.97 at the Westerly plant and $4.92 at the Southerly; while the costs of incineration are $5.10 and $3.86 respectively.[X29]

(For X, see August Bibliography)

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

Treating Supernatant By Sedimentation

Experiments conducted at the Baltimore sewage works in treating supernatant sludge liquor included coagulating with a 10% solution of ferric chloride and settling for 2 hr., then determining the 5-day B.O.D., suspended solids and turbidity. A 5 to 10-second period of mixing of coagulant with sludge seemed the optimum, using a mixer operating at 600 to 800 rpm, the mixture flowing immediately to a sedimentation tank without flocculation. B.O.D. removal was best at pH 5.0, but high removal of suspended solids was obtained at any pH from 4.0 to 11.0. Using 400 ppm of ferric chloride gave the best results, but 300 was almost as satisfactory.[C64]

Bulking of Activated Sludge

"Bulking" is a general term. It may mean rising of the sludge blanket until the sludge passes the weir; or great increase in sludge volume accomplished by loss of density. It may be caused by flotation of floc by gas bubbles or by filamentous organisms, or other conditions. Bulking can be produced experimentally by heavy doses

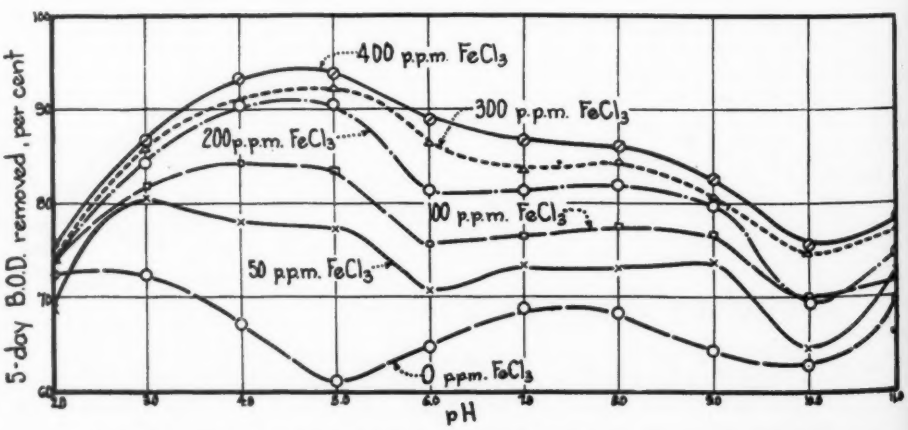

FIG. 5.—Removal of 5-day B.O.D. from sludge liquor when treated with various amounts of $FeCl_3$. (pH—2.0 to 11.0; coagulant mixed for 10 sec.; mixer speed—600 r.p.m.; sedimentation period—2 hr.) Courtesy Sewage Works Journal

Coagulating with ferric chloride at Baltimore

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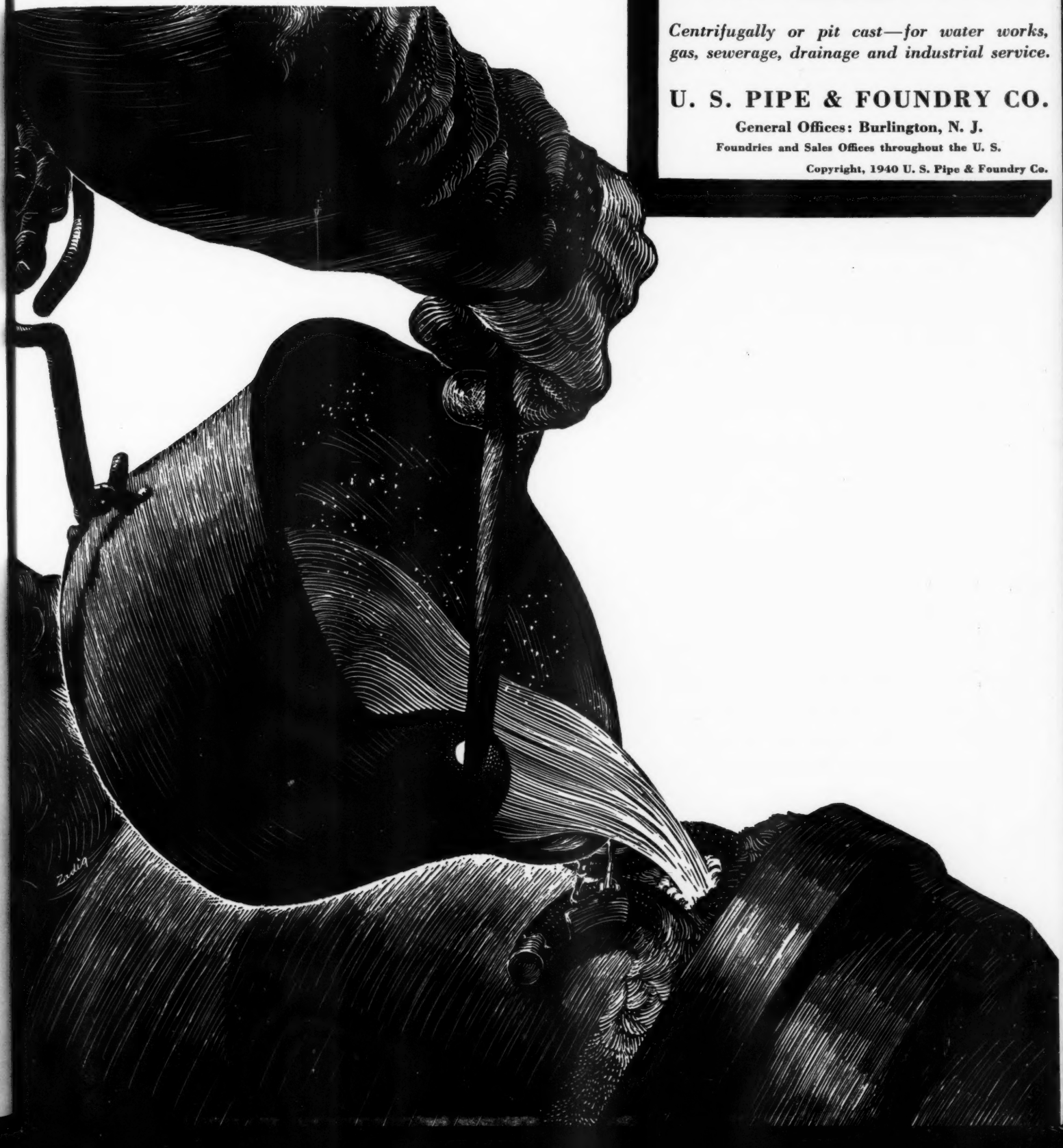

of sugars, or by mixtures of nitrogenous and carbonaceous compounds. Such bulking may be associated with several organisms, but the predominant one usually is the filamentous bacterium *Sphaerotilus natans* Kutzing, which gives abundant growth on solutions of sugar if a suitable source of nitrogen is present. Its settling qualities are poorer than those of any other fungi tested. No substance toxic to *Sphaerotilus* has been found that is cheaper or more available than chlorine.[C60]

In laboratory experiments, *Sphaerotilus* sludge in concentration of 757 ppm removed a maximum of 46% turbidity and 56% B.O.D. from sterile sewage in 4 hours' aeration. Rapid adsorption of suspended organic carbon did not occur, although a limited slow removal of it was observed; most of the carbon removed by *Sphaerotilus* was dissolved organic. The limited uptake of suspended carbon was probably due to the absence of the gelatinous masses and great adsorbing surface characteristic of both *Zooglea ramigera* and natural activated sludges. The fungus sludge appeared white and fluffy with a volume approximately 3 times that of an equivalent amount of zoogleal sludge. The sludge masses produced were composed of non-gelatinous threads of the organisms. Certain types of bulking in natural activated sludge appear to be the result of overgrowth of the sludge by filamentous organisms, notably *Sphaerotilus*. The sludges produced have high sludge indices and exert a moderate purifying action on sewage.[C61]

No instances of bulking have been reported with carbohydrate-free sewage under laboratory conditions, but there are many instances in activated sludge plants where appreciable amounts of available carbohydrates, such as sugars and starches, cannot be detected in the sewage. The quantity and type of carbohydrate, the amount of nitrogenous material, the quantity and condition of the sludge, all play an important part in bulking. The proper combination of these factors induce an undue development of *Sphaerotilus*. With a given sewage load and sludge concentration, the rate of bulking is dependent upon the quantity of air. With a given sewage load and quantity of air, the rate increases with increasing suspended solids concentration in the activated sludge mixture; beyond certain concentrations, the rate of increase in sludge index decreases. A more highly oxidized sludge bulks less readily than a poorly oxidized sludge. The addition of 10-20 ppm nitrate nitrogen prevents bulking. The stronger the sewage the more readily it causes bulking. Of the two methods of dosing with a given amount of sewage load, the more frequent additions of a dilute sewage results in the maintenance of the initial sludge index, while the less frequent addition of a stronger sewage gives an increase in the sludge index. The higher the temperature the greater the increase in the sludge index, provided the purification mechanism is not impaired by a deficiency of oxygen on account of the higher oxygen demand at the higher temperature. Reaeration of sludge with a limited oxygenation capacity may result in an increase in sludge index, especially with higher sludge concentrations. Oxygenation capacity is determined primarily by the design of the aeration tank, quantity of air, detention period and temperature; once an aeration tank is designed for a sewage flow of a given strength, there is little that the operator can do in a fundamental way to prevent bulking. It may help if he increases air supply or reduces sludge concentration by returning effluent or diluting with stream water. When bulking occurs in the absence of carbohydrates, deficiency of oxygen is the factor of prime importance. Bulking may be used as a practical yardstick

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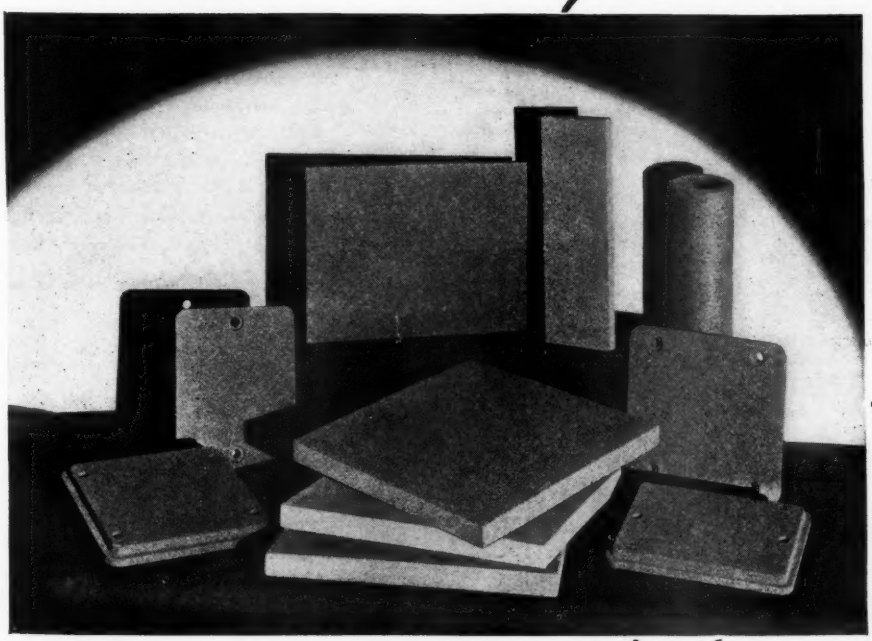

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for determining the efficiency of the aeration system.[C62]

Typhoid Bacteria In Sewage Sludge

Investigations in Java, where typhoid is much more prevalent than in Europe, discovered typhoid bacteria in most streams and in practically all sewages. During passage through an Imhoff tank, approximately 80% of the typhoid bacteria settled with the sludge. They died off rather quickly in the sludge but still could be found in the digested sludge drawn from the tank. After drying the sludge, however, typhoid bacteria could not be isolated.[C63]

Turbidimeter Control of Plants

If there can be established a definite relation between turbidity and B.O.D. of effluent from chemical precipitation, this test can be used in place of 5-day B.O.D. tests for determining optimum chemical doses. The author, using a Jackson turbidimeter, found this entirely satisfactory at Essex Fells, N. J. using chemical coagulation and sand filters. "However, it is not recommended that the turbidity reading be substituted for analyses for B.O.D. and suspended solids but should be correlated with said analyses and used as an index of their presence or obsence both qualitatively and quantitatively." W. A. Darby believed that definite relationship may be established in the case of rather clear effluents, but not always with packing house wastes and effluents from trickling filters and activated sludge. It would undoubtedly be necessary for the plant operators to run a considerable number of tests along with blank samples before a reasonable average figure could be established; also to determine the relationship for each day of the week.[X36]

Pretreating Industrial Wastes

Middlesex Borough, N. J., requires pretreatment of industrial wastes before discharge into the public sewers, prescribing the kind of pretreatment and specifying certain requirements as to the resulting effluents, such as residual chlorine, pH etc. and distribution of flow throughout the 24 hrs.; also payment to the borough (yearly in advance) at a certain rate ($33 in one case) per million gallons discharged. In determining requirements, the borough analyzed hourly samples and measured the flow. For a fruit glazing plant it specified a 30,000 gal. storage tank, chlorination and lime feeding equipment, maintenance of 1.0 ppm

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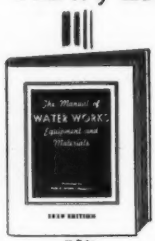

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chlorine residual and 7.0 pH. For a film developing and fixing plant the residual and pH requirements were the same. For a manufacturer of insecticides, where the effluent was high in arsenicals, laboratory tests showed that small amounts of calcium arsenate stimulate digestion but larger amounts delay it, and any amount of paris green delays it; and requirement was clarification to 10 ppm suspended solids, which was met by use of a filter press; and incidentally the company found recovery of arsenic in the filter press cake to be profitable.[X38]

Ventilating a Treatment Plant

Manasquan, N. J., treats the sewage of 6,000 summer population (2400 in winter) by pumping it into four septic tanks, the overflow from which is discharged into the ocean 1000 ft. from shore. The sludge accumulating in summer is pumped into the ocean during late fall and winter. The tanks are roofed over at beach level and used as parking space. Summer cottages surround the plant, some only a few feet away. Owing to the length and flat slope of the sewers, the sewage reaches the tank stale and high in H_2S, and the odors at the plant were serious. They have been satisfactorily eliminated by a ventilation system, which draws air through ducts from screen house, pump house, settling tank, sludge pump and chlorine room and discharges it into a shaft of galvanized copper steel 75 ft. high (there are no tall buildings in the vicinity), the exhaust fan having a capacity of 3900 cfm at 4 inches pressure. Air from out doors enters the chlorinator room, passes down the stairs, over the chlorine contact tank, then into the space above the septic tanks and through this to the chimney. The suction system is of cast iron. The asphalt-coated steel plate fan housing corroded badly. It is estimated that, with the tanks producing gas at the rate of 0.8 cu. ft. per capita per day, it would be mixed with 1000 times its volume of air and so be non-explosive. Since the ventilation system started there have been no complaints of odors.[X33]

High-Rate Sand Filters

Intermittent sand filters at Rockaway Valley, N. J. treat the sewage from 9,000 people per acre, giving a clear and sparkling effluent that never has carried a measurable amount of suspended solids, and in relative stability tests has never lost color in six weeks incubation. There are 6 acres of sand 2½ feet deep, effective size 0.4 to 0.6 mm. Fresh sewage is first passed through sedimentation tanks and contact beds. Much credit is given to the ridging of the sand beds; the sand is ridged 0.8 ft. high on each side of 5 ft. channels which are connected by cross cuts through the ridges, which are just about submerged at the end of a week's run, and act as breathers, preventing air locking. The beds are given a light raking at the end of each run. A sand washer permits the cleaning and re-use of soiled sand.[X39]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

C *Sewage Works Journal*
July

60. *t.* Sphaerotilus Natans Kutzing and Bulking of Activated Sludge. By J. B. Lackey and E. Wattie. Pp. 669-684.
61. *t.* Carbon and Nitrogen Transformations in Activated Sludge Process With a Culture of Sphaerotilus. By M. L. Littman. Pp. 685-693.
62. *t.* Bulking of Activated Sludge Induced by Domestic Sewage. By H. Heukelekian and R. S. Ingols. Pp. 694--714.
63. *t.* Typhoid Bacteria in Sewage and Sludge. By C. P. Mom and C. O. Schaeffer. Pp. 715-737.
64. *t.* Treatment of Supernatant Sludge Liquor by Coagulation and Sedimentation. By C. E. Keefer and H. Kratz, Jr. Pp. 738-744.
65. *t.* Sewage Treatment Experiments Conducted at the Los Angeles City Pilot Plant. By H. G. Smith and E. G. Studley. Pp. 745-759.
66. A Year's Experience in Digestion of Sewage and Garbage Solids. By G. F. Wyllie. Pp. 760-770.
67. Treatment of Tannery Wastes at the Griess - Pfleger Tannery, Waukegan, Ill. By J. W. Harnley, F. R. Wagner and H. G. Swope. Pp. 771-799.
68. Sewage Works Records. By P. J. Kleiser. Pp. 800-802.
69. Apparatus for Determination of Hydrogen Sulfide in Sewage and Polluted Water. By G. Martin. Pp. 803-804.
70. A B.O.D. Dilution Dispenser. By D. Backmeyer and W. E. Ross. Pp. 805-806.
71. A Pump Cleaning Gadget. By P. W. Richards. Pp. 806-807.
72. Sewage Gas Utilization Systems. By L. L. Langford. Pp. 807-815.

D *The Surveyor*
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22. Sewage Disposal at Rochdale. Pp. 19-20.

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23. Sewerage and Sewage Disposal at Singapore. P. 33.

E *Engineering News-Record*
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20. Refuse and Sewage Plant Combined for Profit. By G. O. Consoer and D. W. Townsend. Pp. 53-56.

G *Water Works & Sewerage*
August

23. Oil Field Waste Water Disposal. By W. Humphreys and A. M. Rawn. Pp. 341-346.
24. Sewage Filtration With Silica Sand Filters. By P. B. Streander. Pp. 351-357.
25. Sewage Treatment Projects of Ossining, N. Y. By J. C. Harding. Pp. 358-364.

H *Sewage Works Engineering*
August

34. Modern Treatment for Albuquerque, N. M. By H. C. Neuffer. Pp. 364-366.
35. Industrial Waste Treatment in Maryland. Pp. 369-371.
36. Treatment of Wastes From Citrus Juice Canning Plants. Pp. 371-384.
37. Refuse Incinerator at 56th St., Manhattan, N. Y. By H. W. Taylor. Pp. 372-373.

J *American City*
August

17. Small-Town Plant for Sewage Treatment (Excelsior, Minn.). Pp. 35-37.
18. Refuse Disposal in New Rochelle, N. Y. By T. R. Kendall. Pp. 44-46, 73.
19. New Sewage Treatment Plant at Lansing, Mich. Pp. 50-51.

L *Civil Engineering*
August

5. Effect on Animal Health of Feeding Sewage. By A. B. Crawford and A. H. Frank. Pp. 495-496.
6. Pollution Abatement in New York City. By R. H. Gould. Pp. 508-509.

P *Public Works*
August

39. *p.* Treatment Methods for Waste from Citrus Juice Canning Plants. Pp. 7-8.
40. Sewage Plant Operation at Grand Forks, N. D. P. 8.
41. Designing and Building a Reinforced Concrete Drain. By I. R. Riker. Pp. 13-14.
42. Design Details for Trickling Filter Underdrains and Ventilation. Pp. 17-20.
43. *n.* Sewer Infiltration at Fort Worth. P. 20.

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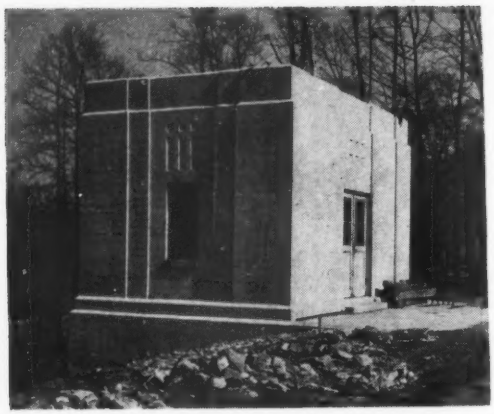

Gate house at sedimentation tank of Ashland, Ky., waterworks.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

Control of Plankton Growths

Plankton growths in the large slow sand filter plant settling basin at Indianapolis, Ind. is being controlled by use of combinations of copper sulfate, chlorine and ammonia, following coagulation and prechlorination. A dose of 0.3 ppm of each was found insufficient, and a maximum of 3.0 ppm was adopted. Each is useful to certain organisms. *Achnanthes* resists more than 1 ppm of copper sulfate but is destroyed by 0.25 ppm of chlorine. Another organism withstood 4 ppm of chlorine when the water demand was about 3, but was eliminated by 2 ppm of copper sulfate. There is no virtue in use of the combination of all three except when each is most effective for some one or more of the organisms present. Unless ammonia is needed to form chloramine, it is better omitted because it is a bacterial food and may result in formation of nitrites and odors.

Sunlight rapidly dissipates even amines, and large chlorine excess is needed, even exceeding the break point, to carry water in a basin through a bright day if aftergrowth is to be prevented.[A122]

Algae Control At Appleton, Wis.

During most of the summer of 1939 the river supplying water for Appleton contained more than 10,000 csu of plankton per ml—9,000 Anabaena and 6,000 Microspira at different times, and quantities of fish were destroyed. An aerator with four sets of 18 "Spraco" nozzles during warm weather reduced the odors 40% to 50%; with cooler water and reduced odor the efficiency fell to 25%. As they found that odor removal by carbon requires much more than 1 ppm per unit of threshold odor removed (see A125), aeration during the summer is estimated to save at least $9 per mg in cost of carbon; but when odor reduction is below 4 ppm aeration seemed not profitable.

Before adding activated carbon to highly polluted water, as much as possible of the organic matter was first removed by sedimentation, the sludge being removed at short intervals. Superchlorination up to 31 ppm apparently did not reach the break point. Filters clogged rapidly and passed as high as 100 csu of algae and large numbers of bacteria. Application of chlorine to the filters was of slight benefit; copper sulfate was worse than useless. Much odor was removed by applying up to 10 ppm of carbon.

Lime treatment at Neenah reduced algae count from 3850 to 39 csu and reduced the chlorine demand about 50%.[A123]

Odor Control On Lake Michigan

Excessive tastes and odors were experienced in 1939 by cities taking water from Lake Michigan. Of 12 investigated, 11 found this due to microorganisms. Raw water odors ranged from 10 to 100 threshold. At Milwaukee odors jumped from 5 to 45 in a few hours. The protozoan *Dinobryon* seem to be chiefly responsible. Most plants used activated carbon, in doses of 22 to 390 lb. per mg—the latter, being the maximum capacity of the feeder, reduced the odor from 100 to 9.

Milwaukee treats its water normally by coagulation with alum and lime, prechlorination and post - treatment with chlorine and ammonia. They found that, after proper control of carbon application had been established, application of approximately 1 ppm of activated carbon for each threshold unit gave satisfactory results. Glencoe, Ill., obtained satisfactory results with superchlorination and dechlorination with sodium bisulfite.[A125]

Super-Chlorination For Iron and Sulfur

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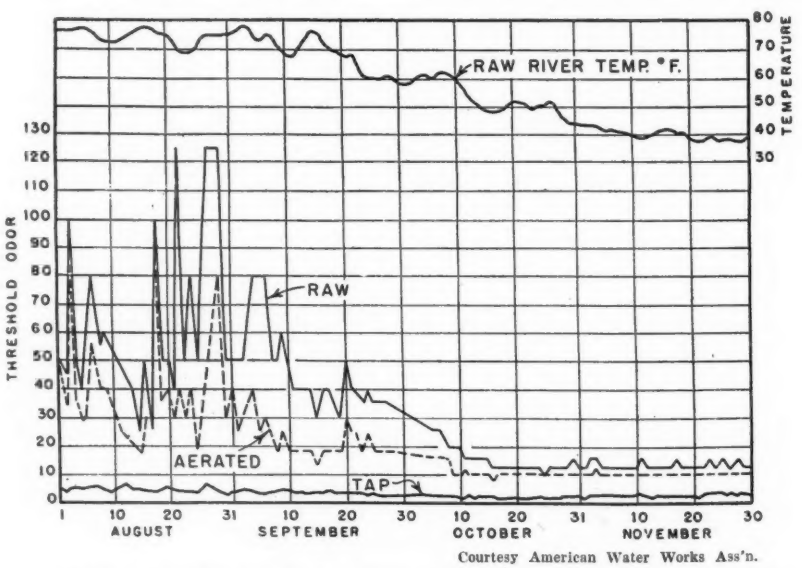

Courtesy American Water Works Ass'n.

Effect of aeration during the summer and fall of 1939, Appleton, Wis.

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Ozone Processes, Incorporated, is an operating member of a well-established and soundly financed group, which has been serving American industry for over 60 years. The management is experienced and keenly aware of its responsibility to the Water Works Industry. This explains the thorough research and skilled engineering supporting every move we make in this field.

tion system; then must be supplemented by coagulation and filtration. Dechlorination can be effected by activated carbon or by any of several chemicals that react with chlorine to produce a tasteless product; choice of the agent is determined by economy and physical conditions of plant. Experience of the Southern California Water Co. has been limited to carbon and sulfur dioxide. Carbon has the advantages that, if super-chlorination is not quite reached, it will remove certain of the remaining tastes and odors; and it dechlorinates variable rates of flow. Sulfur dioxide can be fed economically only through constant-rate feed machines; its use is limited to points of injection at low pressures; and temperature of cylinders and feed machines must be kept constant (93°F at this plant). Sodium bisulfite can be fed under pressure by a Proportioneers pump. There is no law yet determined for capacity of granular activated carbon, but this company uses 1 gpm per cu. ft. of carbon, as standard, limiting it to 2 gpm.[A120]

Water for Industrial Uses

A Committee of the New England Water Works Association has presented a progress report on "Quality Tolerances of Water for Industrial Uses." The report suggests limits allowable in the process water used for air conditioning, baking, brewing, canning, carbonated beverages, confectionery, cooling, distilling, other food, ice, laundering, plastics, paper, rayon, tanning and various textiles; also for boiler feed water for four ranges of pressures—0 to 150, 150 to 250, 250 to 400, and over 400. The limits for high pressures are very low, and many public supplies can not be made to meet them except at unwarranted cost, and supplementary treatment by the users may be necessary. Tolerances are given for 14 qualities of water.

For the various industrial uses the qualities considered are turbidity, color, hardness, iron, manganese, total solids, alkalinity, odor and hydrogen sulphide. The limits vary widely; for example, turbidity of 50 may be allowable for the manufacture of some paper, but should not exceed 5 for high-grade light paper, and a limit of 0.3 is set for rayon manufacture. Iron and manganese are especially important in most industries, and a limit of 0.02 is set for clear plastics and 0.0 for rayon manufacture, and the maximum for any industry is 1.0. In dyeing it is important that all qualities remain constant throughout the year.[B26]

Cathodic Tank Protection

Protection of steel water tanks by cathodic equipment is in use in about 600 tanks. This requires one or more electrodes (usually stainless steel or graphite) suspended in the tank and a source of electric current—usually a transformer, a dry-type of rectifier and suitable controls, so connected that direct current runs from the electrode to the tank, depositing ionic hydrogen and calcium or other positive ions on the inner surface of the tank. This equipment cost $400 for a 350,000 gal. tank (painting the interior would have cost $700) and a little more for a 750,000 gal. tank, painting which would have cost $950. Reports from a number of users show the installation cost to have been $198 to $525 and the annual maintenance cost from $3 to $25 a year.[A113]

In cold climates provision should be made to prevent the electrode from being frozen in ice that may form in the tank. In an Indianapolis installation a heating element was built into each electrode. To avoid this danger it is

INDIANAPOLIS WATER COMPANY BUILDS A NEW FILTRATION PLANT

A fine new 16 million gallon rapid sand filtration plant, designed by their engineers, is in building. Architectural attractiveness, combined with new conceptions in plant structures and the adoption of advanced operating equipment, will make this an outstanding plant in the field of water filtration and purification.

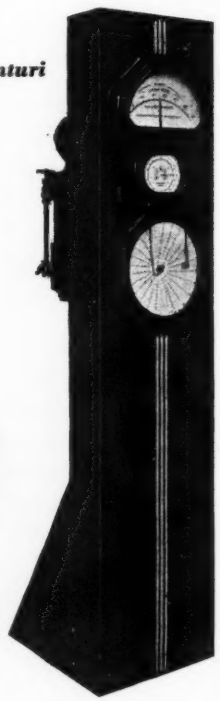
Venturi Tube

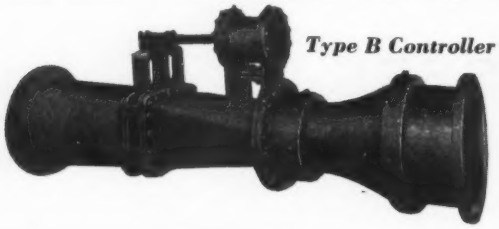
The Main Line Meters, the Filter Effluent Controllers, and Gauges will be *100% Builders Venturi.*

For 38 years we have had the privilege of supplying this progressive Water Company's needs for such equipment. Could there be any higher indorsement?

Recently published Bulletins are available to engineers and superintendents.

Type M Venturi Meter





Type B Controller

Flo-watch

Quality, a Tradition for over 100 years

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Install Lock Joint Pipe — and be assured of

no corrosion and no tuberculation

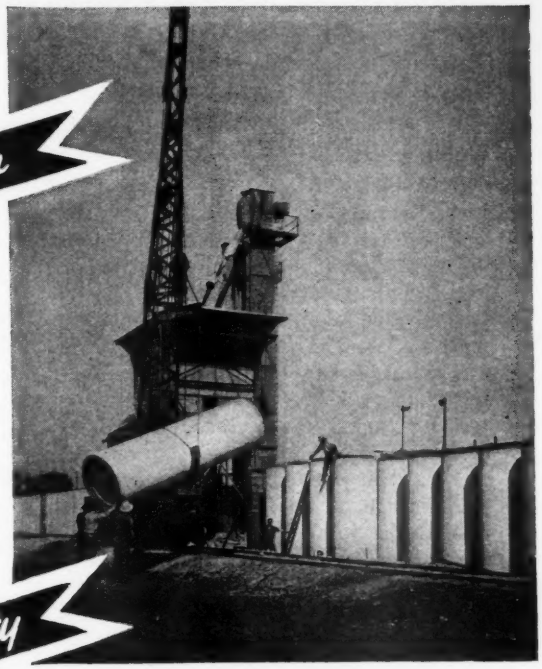
Because Lock Joint Pipe is made of concrete and concrete has long been recognized as *the* material which most completely protects metals from corrosion.

Furthermore—concrete, used as a surface for the transportation of water—cannot tuberculate.

— and be assured of

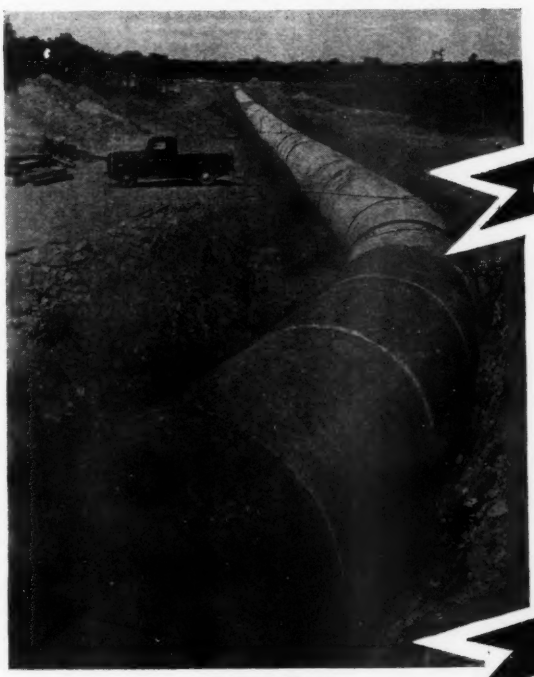
sustained high carrying capacity

Tests made on Lock Joint Pipe Lines after 9 and 18 years of continuous service are now showing values of "C" = 147 (Hazen-Williams).



GRAND RAPIDS, MICH.
Manufacturing 163,100 ft. of 46″ diameter Lock Joint Reinforced Concrete Pressure Pipe for the new Lake Michigan Water Supply Line.

Unlike other pressure pipes, Lock Joint Reinforced Concrete Pressure Pipe is made right on the job. As a result local manufacturers and merchants benefit by the purchase of materials and equipment and the community also gains because of the employment of local labor.



BOSTON, MASS.
Part of the 66,000 ft. of 138″ dia. Lock Joint Reinforced Concrete Pressure Pipe installed for the Metropolitan District Water Supply Commission.

Lock Joint Pipe has

water tight expansion joints

The measured average leakage on all Lock Joint lines is well below the allowable—convincing proof of the efficiency of the joints. Sufficient expansion and contraction is permitted at each joint to allow deflections due to extreme changes in temperature and normal earth movements.

This results in a

long life -- free of repairs

Inherent freedom from corrosion and tuberculation—initial and sustained high carrying capacity—complete water-tightness—self-centering flexible joints — negligible repairs and maintenance — life conservatively estimated at 100 years or more — all combine to make Lock Joint the pipe that can be put in the ground — and forgotten!

LOCK JOINT *Reinforced Concrete* PRESSURE PIPE

LOCK JOINT PIPE CO. Established 1905 AMPERE, N. J.

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more or less common practice to place the electrodes below supposed low water in the tank.[A114]

Life of Standpipes

Based on data concerning 111 steel and iron standpipes in New England and New York built a number of years ago, the author concludes that, of the 67 still in use, the probable average service life can be estimated at 54 years. Of the 44 that have been abandoned, the average life was 32 yrs., but most of them were abandoned because they were superseded by other structures, had become inadequate to meet increasing needs, or were at too low elevations for satisfactory service.[B18]

Cost and Value of Meter Maintenance

During the years 1931 to '39, Hartford, Conn., modernized its meter repair equipment and methods, setting more rigid standards for repair and testing. In spite of the latter, probably because of the better equipment, the average cost per meter repaired decreased from an average of $5.91 in 1931-'33 to $5.03 in 1937-'39. With about 29,000 meters in service, from 5,000 to 6,000 meters a year are being repaired at a cost of $28,000 to $30,000. Investigation whether improvement in meter maintenance with consequent increase in meter accuracy produced increased revenue was made by three methods, one of which indicated an increase in revenue of 3.7%, another 4.5% and the third 5%. These results "should be taken as a trend, indicating worthwhile economy, rather than as a precision measurement."[B20]

Welding Steel Pipe to Cast Iron

At Racine, Wis., a 42" steel branch was welded to a 42" cast-iron pipe, the steel pipe ⅜ in. thick, the cast iron 1½ in. First ¼ in. holes 1" deep were drilled along the line to be cut, spaced 1" to 1½" apart. The cut then was made by oxy-acetylene flame in 1 hr. 48 min., using 2 tanks of oxygen and 1.2 tanks of acetylene. Grinding the edge of the cut took 1½ hr. A charcoal fire inside the pipe raised its temperature to 400° F. and two men welded the joint in 4 hrs., using 0.8 tank of acetylene and 0.4 tank of oxygen and 25 lb. of C.I.G. ready-flux red bronze rod. The pipe was 13 hr. out of service. Cost was much less than to install a 42" branch.[F67]

Cross-Connection Testing Laboratory

With the cooperation of the State Department of Public Health, the New Bedford, (Mass.) Vocational School, which has about 50 students in the course of plumbing and heating, has established a testing laboratory in which to study and demonstrate the operation of plumbing fixtures and possibilities of contaminating the water supply connected therewith. The various types of flushing tanks and flushometer valves are installed, and a great deal of the piping is transparent lucite, and some of the flushing tanks have transparent faces. A vacuum equivalent to 21" of mercury can be applied at different points. With vegetables dyes in the water it is possible to learn what goes on under any condition in any of the apparatus.[B21]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n. July*

113. Cathodic Protection of Steel Water Tanks. By E. E. Norman. Pp. 1069-1074.

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HAND or WET PROCESS

Make concrete pipe on the job with QUINN PIPE FORMS. Quinn Pipe Forms can be handled by less experienced labor and produce uniform concrete pipe of highest quality The recognized standard of all concrete pipe

HEAVY DUTY CONCRETE PIPE FORMS

Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length. Backed by years of service in the hands of contractors, municipal departments and pipe manufacturers.

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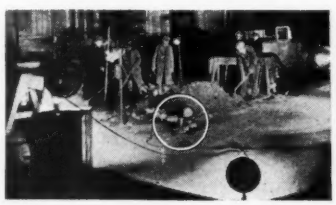

USE A HOMELITE PORTABLE GENERATOR

FOR NIGHTWORK

You can't find a better, easier, or handier way to give workers low-cost, time-saving floodlighting for night work than with a Homelite Portable Generator. Weighing only 82 pounds—complete with built-in gasoline engine—the complete unit is easy to get around. Automatic in every respect, it requires little manual attention. Yet it gives you all the power you need for brilliant floodlighting.

FOR DAYWORK

Smart maintenance men are also capitalizing on the 1800 watt output of a Homelite—and its ability to do a load of work without breakdown—by using them to operate small electric tools. It makes an ideal set-up for work where electricity is not readily available. Cuts hours off a job. Saves money in every instance. Send for our new illustrated bulletin showing all sizes and complete specifications.

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114. Steel Tank Corrosion Prevention. By W. C. Mabee. Pp. 1075-1080.
115. Legal Decisions Relating to Distribution of Public Water Supplies. By F. A. Marston. Pp. 1081-1096.
116. Modern Trends in Legal Liability. By G. R. Redding. Pp. 1097-1100.
117. Annual Report of a Small Water Works. By L. E. Jarvis. Pp. 1101-1106.
118. Is It Profitable and Practical to Have Accurate Meters, Sensitive to Low Flows. By L. V. Trentiage. Pp. 1107-1117.
119. Active Problems in Water Purification. By P. Hansen. Pp. 1118-1136.
120. Control of Iron and Sulfur Organisms by Super-Chlorination and Dechlorination. By L. J. Alexander. Pp. 1137-1146.
121. Super-Chlorination at Ottumwa, Ia. By H. A. Brown. Pp. 1147-1154.
122. Treatment with Copper Sulfate, Chlorine and Ammonia. By C. K. Calvert. Pp. 1155-1164.
123. Control of Algae at Appleton, Wis. By W. U. Gallaher. Pp. 1165-1175.
124. Super-Chlorination with Ferrous Sulfate Dechlorination. By W. Strockbine. Pp. 1176-1182.
125. Taste and Odor Control on Lake Michigan. By N. A. Thomas. Pp. 1183-1186.
126. Observations on Break-Point Chlorination. By A. E. Griffin. Pp. 1187-1190.
127. Developments in Taste and Odor Control. By H. F. Laughlin. Pp. 1191-1194.
128. General Discussion on Water Purification. By J. R. Baylis. Pp. 1195-1197.
129. Discussion on Water Purification. By N. J. Howard. Pp. 1198-1200.

B *Journal, New England Water Works Ass'n*

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18. The Useful Life of Iron and Steel Standpipes. By C. W. Sherman. Pp. 149-154.
19. Hydraulic Investigation of a Small Water Works System and Effects of Main Cleaning. By R. H. Ellis. Pp. 155-163.
20. Results of Better Maintenance and Sizing of Water Meters. By H. W. Griswold. Pp. 164-178.
21. Cross-Connections and the Plumbing Testing Laboratory in the New Bedford Vocational School. By E. J. Sullivan. Pp. 179-185.
22. Lessons from Floods and Hurricane at Ware, Mass. By G. F. Merrill. Pp. 186-190.
23. Explosives—Types and Uses. By C. H. Blocher. Pp. 191-193.
24. Real Estate Acquisitions for Metropolitan Boston's Water Supply in the Swift River and Ware River Watersheds. By J. A. Christenson. Pp. 194-255.
25. Pictures and Public Relations at Westfield, Mass. By H. H. Angell. Pp. 256-257.
26. Quality Tolerances of Water for Industrial Uses. Committee Progress Report. Pp. 261-274.

E *Engineering News-Record*

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31. An Old Softening Plant Goes Modern (Owensboro, Ky.). By E. L. Filby. Pp. 66-68.

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32. A New Pipe Formula. By L. S. Rhodes. P. 45.
33. Designing and Laying 30 Miles of 48-Inch Main for Wichita, Kans. Pp. 46-50.

F *Water Works Engineering*

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69. Maintenance, Field and Office Methods at Chattanooga. By N. N. Wolpert. Pp. 968-971.
70. Diesel-Driven Pump Cuts Power Cost 58%. By J. R. Boundy. Pp. 975-976.
71. Two-Inch Cast Iron Pipe in Modern Water Works Practice. By C. D. Cox. P. 983.
72. Materials for Distribution Pipes. Pp. 995-996, 1000.

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73. How to Increase the Efficiency of a Distribution System. By L. A. Smith. Pp. 1018-1020.
74. *p.* New Supply for Wichita, Kans. By R. E. Lawrence. Pp. 1021-1027.
75. Planning the Distribution System. Pp. 1043-1044.
76. New Attractive Tank Replaces Two of Older Construction. By V. O. Ketcham. Pp. 1047-1048.

G *Water Works and Sewerage*

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29. Softening Plant of the Metropolitan Water District of Southern California. By C. P. Hoover, J. M. Montgomery and W. W. Aultman. Pp. 347-350.
30. *p.* Cross Connections to Steam Boilers. By R. F. Goudey. Pp. 365-367.
31. Treating Incrusted Wells. By J. R. Goetz and F. L. Coventry. Pp. 376-377.
32. Some Experiences in Water Treatment at Reading, Pa. Pp. 378-379.
33. An Algae Blackout. By W. T. Bailey. Pp. 380-382.

J *American City*

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24. New 31-Mile Pipe Line for Grand Rapids, Mich. Pp. 52-53.
25. Iron Removal and Zeolite Softening at Rochester, Ind. By J. Gordon. Pp. 59-60.
26. Water Rates and Service Charges. Pp. 75, 77, 79.

L *Civil Engineering*

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10. Model Studies of Overflow Spillway Sections. By A. S. Offitzeroff. Pp. 523-526.

P *Public Works*

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30. Iron Removal Plant Treats 75 G.P.M. (Norcross, Ga.). P. 16.
31. Remote Control of Youngstown's Pumping Plants. By R. I. Williams. P. 21.
32. *p.* Buried Thermometers Register Depth of Frost. P. 40.

S *Southwest Water Works Journal*

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3. *p.* Maintenance, Repairs and Testing of Water Meters. By A. M. Smith. Pp. 13-14, 34.
4. *p.* Conservation of Our Water Resources. By C. S. Clark. Pp. 15-16, 26.
5. *p.* Control of Plumbing and Raising of Plumbing Standards. By W. E. Jameson. Pp. 19, 22.
6. *p.* Economics of Water Treatment. By L. C. Billings. Pp. 23, 30.
7. *p.* Keeping Filters Clean. By T. C. Green. Pp. 24, 36.

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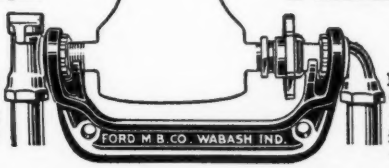
Made in several styles for all types of water meter installations. Gives many advantages.

The original Yoke for water meters. Imitated but not equalled. Hundreds of thousands in service.



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For more than forty years we have specialized in the art of water purification. We manufacture a full line of Water Filters, both pressure and gravity types; Zeolite Water Softeners; Swimming Pool Recirculating Equipment; and various forms of Water Rectification Units. Inquiries are invited on all problems of water treatment.

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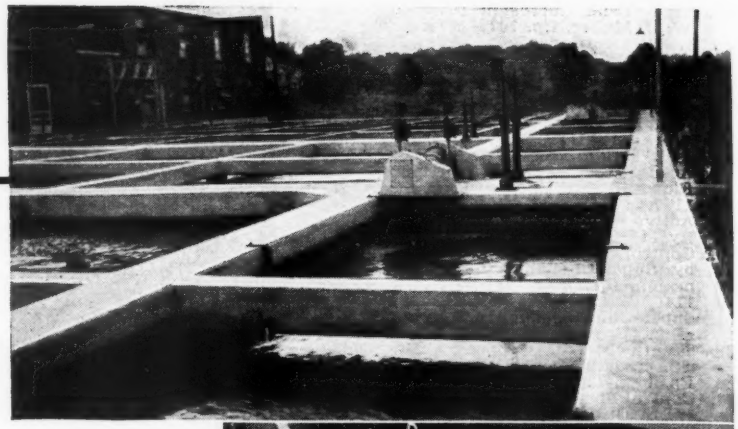
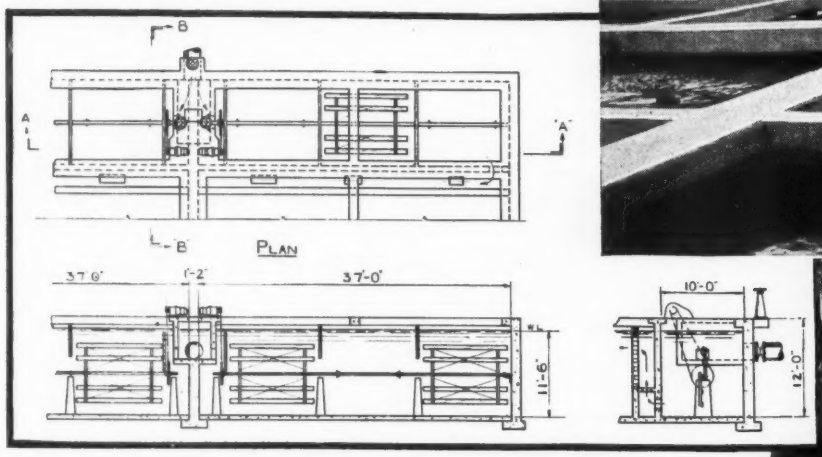
When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 65-67

Filtration plant at Fredericksburg, Va., with mixing tanks on the far side, settling tanks in the foreground.

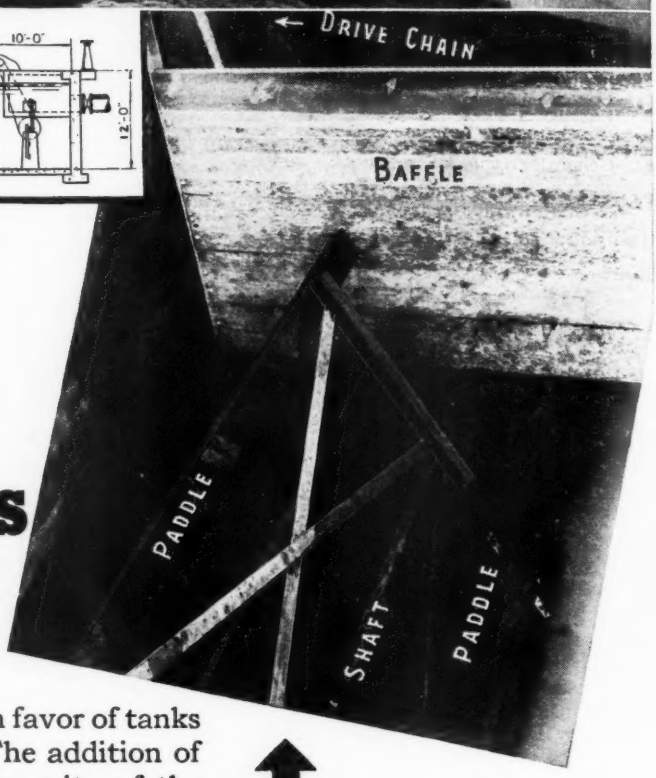


Working drawing showing special arrangement of Link-Belt mixers at Fredericksburg filtration plant



CHEMICAL COSTS *Slashed* with LINK-BELT HORIZONTAL MIXERS

A material saving in chemicals with a 100 percent increase in capacity has been brought about by extensive remodelling at the Fredericksburg, Va., filtration plant. The "around-the-end" type of mixing tank was abandoned in favor of tanks equipped with Link-Belt horizontal mixers. The addition of filters and settling tanks has increased the capacity of the plant from 2 million gallons to 4 million gallons per day. The settling tanks and filters operate at the same rate as previously, yet the chemical dosage has been cut 35% for alum and 50% for lime. This is made possible through the increased efficiency of the flocculation tanks.



The Link-Belt flocculation equipment in each tank consists of a horizontal shaft divided into three sections, each section having four redwood paddles with an outside diameter of 7'0".

LINK-BELT WATER and SEWAGE TREATMENT PLANT EQUIPMENT INCLUDES: STRAIGHTLINE Collectors, CIRCULINE Collectors, STRAIGHTLINE Mechanically Cleaned Bar Screens, Tritor Screens, STRAIGHTLINE Grit Collectors and Washers, Elevated Diffusers, STRAIGHTLINE and CIRCULINE Sludge Collectors for Primary and Secondary Tanks, STRAIGHTLINE Scum Breakers for Digestion Tanks, Reciprocating Distributors, Travelling Water-Intake Screens, and a complete line of elevating, conveying and power transmitting equipment.

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See our EXHIBIT at the Federation of Sewage Works Associations Convention, Palmer House, Chicago, Oct. 3-4-5.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 65-67

Keeping Up With New Equipment

Aluminum grating is light and easy to handle, and it also gives an added attractiveness to the plant. This view was taken at the new Liberty biofilter plant. Grating was furnished by H. J. Thelen Bronze Co., Inc., Brooklyn, N. Y.

Mr. Everson Asks Correction

Mr. R. B. Everson, President of the Everson Manufacturing Co., Chicago, has asked Public Works to correct an error which appeared in a recent advertisement of Everson Sterelators in our August issue.

The incorrect statement which slipped into the Everson advertisement credited the Everson Manufacturing Co., with "over 40 years of pioneering in the waterworks and sewage field," instead of "over 40 years of pioneering in water filtration and purification." Mr. Everson explains that the Everson Company started as manufacturers of domestic and factory water filtering systems, spread to the swimming pool field where they pioneered the recirculating system of water purification and many of the features now standard in public swimming pools, and provided filters for the American Expeditionary Force during the World War, but entered the sewage and municipal water treatment field only after years of research and development of water sterilizing apparatus for other purposes.

Shunk D-K Spreader and Finishing Machine

An advantage claimed for the new power driven D-K spreader and finishing machine, recently announced by the Shunk Manufacturing Company, Bucyrus, Ohio, is its ability to lay a smoothly finished mat of surfacing material over badly worn and rutted roads and streets without need of any preliminary scarifying of the old surface or any filling of holes. The machine rides over the new surface on two crawler type wheels equipped with smooth belt treads, and bumps in the old road surface have little or no effect on the finished surface.

Another feature of the machine is the adjustment for height of the two front wheels. Either wheel may be set to run at a level above or below the opposite wheel to compensate for differences in the subgrade or old surface. Drive provides five speeds both forward and reverse. Two of the three wheels in each crawler unit are driven through a truck type differential. Ample power is available for operating on any grade.

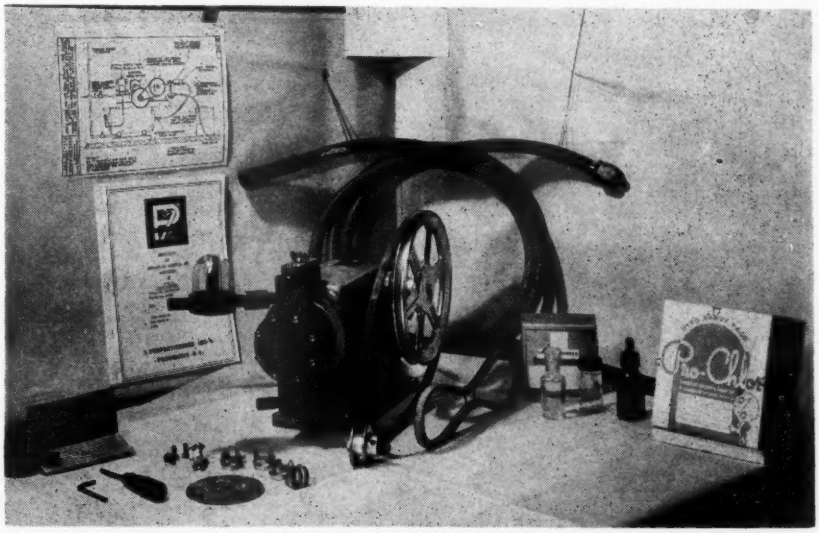
Boring Tool for Installing Underground Pipe

The Hydrauger Corporation, 116 New Montgomery Street, San Francisco, Calif., has introduced a new boring tool, which is designed to drill horizontally any desired size hole from 2½" to 14½" in diameter, for distances up to 120 feet or even more, with remarkable accuracy. It is claimed that this mechanical gopher will bore through sand, clay, conglomerate, rock and shale at exceptional speeds. In cases where pavement cutting permits are refused, this method is about the only satisfactory solution for installing mains, service leads, conduits, cables, culverts and drain pipe. It is operated by an air motor and utilizes a stream of water passing through hollow boring bar sections to sluice-out the cuttings, mud-up the hole and lubricate the bit. A complete fully illustrated bulletin may be secured from the manufacturer.

Shunk Spreader and Finisher

Road Roller Has Rubber Covered Wheels

Shown herewith is a roller manufactured by the Buffalo-Springfield Roller Company, the wheels of which have been covered with rubber. This roller is now being successfully used to roll down a soft stone aggregate known as Brookville stone, similar to a soft limestone, on Florida secondary roads. The steel or iron wheels which are a conventional part of this equipment crush this



This is the "Du-Self" Chlorofeeder just announced by Proportioneers, Providence, R. I. It is designed for small water plants in homes, camps, restaurants, resorts, etc., and is sold as a complete package, to be installed by the purchaser.

Buffalo Springfield roller with rubber-faced rolls.

soft stone to such an extent that its value as road ballast is impaired.

The technical department of the Goodrich company was put to work on the problem, and supplied a rubber compound approximately one inch in thickness for covering the wheels. The twisting action in steering and the tremendous torque imposed on the rubber surfaces made it necessary to have a perfect bond between the rubber covering and the steel roller. The Vulcalock process of bonding rubber to metal which has been so successful in lining steel tanks and covering printing rolls with rubber was used.

The machine was purchased by The McDonald Corporation which leased it to the Florida Crushed Stone Company, which leases it to road contractors.

Bigger Payloads With New 1941 Model Jaeger Truck Mixers

The new drum sizes announced by The Jaeger Machine Co., Columbus, Ohio, for their 1941 Truck Mixers, increase the payload to the maximum that the trucks themselves should carry—loading through the top in one quick drop. More than adequate void space, combined with Jaeger's "Dual Mix," is said to give a faster and more thorough mix, a better quality and more salable concrete.

The new standard capacities compared with previous models are:

2 yd. Size Replaces 1½ yd.
3 yd. Size Replaces 2½ yd.
4 yd. Size Replaces 3½ yd.
5 yd. Size Replaces 4 yd.
5½ yd. Size remains unchanged

The compactness of the mixers is such that the 2 yd. size with 104 cu. ft. drum is easily mounted on short wheelbase, Ford type trucks.

A-C Patrol Grader With Hough Sweeper

The Allis-Chalmers Patrol Grader powered by a Model "W" Tractor is now available with a Hough Front End 6-ft. Power Boom. This is designed to combine in one machine all of the essential operations of secondary road maintenance, road grading, shoulder, ditch and bank cutting and grading, black top, cutting, mixing and subgrade sweeping and snow removal. Blade can be sloped or angled right or left. Broom has controlled ground pressure, sweeps one way and can be used simultaneously with blade where occasion requires.

Details are available from Frank G. Hough Co., Libertyville, Ill., and Allis-Chalmers distributors.

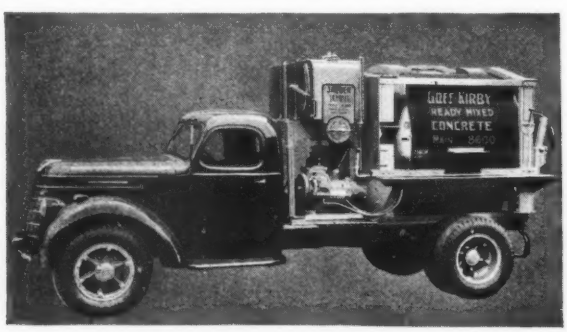
New Type Reflecting Signs

New type reflectors, link-mounted in the form of a chain, are manufactured by The Star-Lite Company, 312 East Market Street, Indianapolis, Indiana. This reflector chain is flexible and may be mounted on any surface with aid of screw driver or hammer; it tacks on like tape or fastens with screws to sheet metal, wood or plastic to form desired letters, symbols or numbers. The reflectors are of a new multiple reflex type, individually molded, returning brilliant lustrous light at a great distance and at extremely wide angles. The manufacturer also makes pavement surface markers and reflector chain for highway markers such as traffic signs, bulls-eyes, post and berm lights.

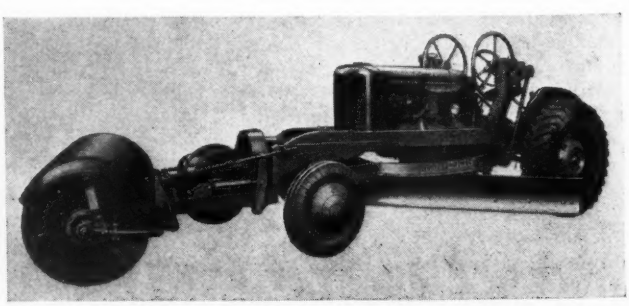
Mounting reflecting chain

LeTourneau Small Tournapull

Combining the speed of a truck and the power of a tractor with a capactiy for the average job and scraper self-loading and self-spreading economy, R. G. LeTourneau, Inc., Peoria, Ill., has developed its third and smallest Tournapull, known as the Model C, for long haul dirt moving. Powered by a "Caterpillar' four cycle, six cylinder D-468 Diesel engine, it has a top speed of 13 to 15 miles per hour, depending upon tire equipment. Two different size tires are available for the Model C Tournapull to meet job requirements and needs, 21 x 24s and 18 x 24s. The Model C is the third Tournapull size now available to earthmovers. The first Tournapull introduced was the Model



The new Jaeger truck mixer



Hough sweeper on Allis-Chalmers grader

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CARL H. FRINK, Mfr.
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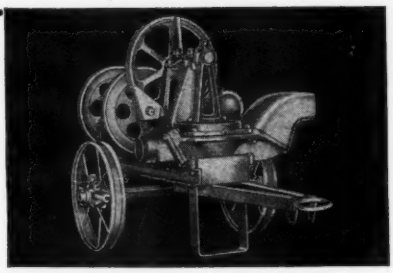
C.H.&E.
SINGLE and DOUBLE DIAPHRAGM PUMPS
SEWAGE and TRASH PUMPS



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FOR NEW OR RESURFACE JOBS

The model C, newest and smallest Tournapull

A, which operates with either NU, 45-yard; N, 33-yard; or RU, 30-yard, Carryall scrapers or a 30-yard Tournatrailer. The Model B Tournapull pulls either a Carryall or a Tournatrailer rated at 19 cubic yards heaped measure.

Valves

An 8-page bulletin on the Howell-Bunger valve, which has unusually high discharge efficiency. Primarily designed for use in dams and other locations where high pressures and large discharges are required. Ask for Bulletin 144: S. Morgan Smith Co., York, Pa.

Engineering Society of Western Pa. Water Conference

A water conference will be held at the William Penn Hotel, Pittsburgh, Pa., Nov. 12 and 13, 1940, covering water quality and pollution control, new treatment methods and designs and latest developments in boiler water conditioning. A number of recent municipal plants will be described.

Georgia Water and Sewage Association

The Georgia Water and Sewage Association will hold its annual short school on October 16 to 19 at Atlanta, Ga. A tentative schedule has been issued for the course, which will be sent on request to W. H. Weir, Ass't. Director of Public Health Engineering, 245 State Office Building, Atlanta, Ga.

Federation of Sewage Works Associations

The first annual convention of the Federation of Sewage Works Associations will be held in Chicago, Ill., at the Sherman Hotel, October 3, 4 and 5. A tentative program has been announced which is available from Anthony Anable, Dorr Co., 570 Lexington Ave., N. Y.

New England Water Works Association

The 59th annual convention of the NEWWA will be held in New York, N. Y., at the Hotel Commodore, September 24 to 27. There will be six technical sessions, with a large number of papers scheduled for presentation. Business sessions will occupy Tuesday forenoon; in the afternoon there will be awards, followed by technical papers and committee reports. The convention will close on Friday noon.

Civil Service Examinations

Draftsmen. — Examinations for all grades of engineering draftsmen (aeronautical) will be given until June 30, 1941. Applications will be rated as received and certifications made without further examination as vacancies occur. U. S. Civil Service, Washington, D. C.

Assistant Engineer, Board of Water Supply, New York.—Examinations will be held in New York, Boston and Knoxville, Tenn., until September 23. $3120 per year minimum. Requirements and other data from Municipal Civil Service Commission, New York City, N. Y.

PERSONAL NEWS

The following new appointment as city manager has been reported:
Roy R. Hislop, Phoenix, Ariz.

The following new appointments as city engineers have been reported:
John A. Mancini, Hayward, Calif.
Victor McCormick, Atlantic, Iowa.
Nathan B. Barber, Waterloo, Ia.
J. B. Metcalfe, Chestertown, Md.
George Huntley, Bellevue, Nebr.
J. Willis Harry, Parkesburg, Pa.

The following new appointments as county engineers have been reported:
John E. Jolliffee, Johnson County, Franklin, Ind.
A. W. Gaines, Harrison County, Council Bluffs, Iowa.

The following new appointments as water works superintendents have been reported:
Ernest Brake, Glenwood, Ia.
Chas. F. Smith, Mineola, N. Y.
Wm. B. Irwin, Parkesburg, Pa.

George C. Warren Died July 31st, Aged 76

To paving engineers and contractors whose experience extends back 25 to 50 years, the name of George Warren is familiar. For many years following 1900, when the firm of Warren Brothers was incorporated, it played a leading part in the asphalt paving industry, building hundreds of miles of asphalt pavement in all parts of the United States, Canada and several foreign countries and constantly developing both the science and the art; and it still is a large contractor in that field.

There were seven of the Warren brothers in the company, but probably George was the one best known to the engineers and public officials. He served successively as vice president, general manager, president, and chairman of the board of directors of the company. He was author of many brochures on highway construction practice. He was a faithful attendant at the conventions of the Am. Soc. of Municipal Improvements. During his later years he was especially interested in promoting, as Chairman of the Committee on Sidewalks of that society, sidewalks or paths bordering highways.

The late George C. Warren

He is survived by two sons, Herbert M. and Lewis G., and two daughters; and by the only surviving "Warren brother"—Ralph L.

George B. Gascoigne, consulting engineer of Cleveland, Ohio, died recently after a brief illness. Mr. Gascoigne was 56 years old, and was one of the best-known consulting engineers.

Rolf Eliassen has been apponited associate professor of Sanitary Engineering at New York University, succeeding the late Lewis V. Carpenter.

W. J. Koehring, after 33 years of service as president of the Koehring Co., has resigned and will become chairman of the Board of Directors. G. E. Long, who has been treasurer since 1932, succeeds Mr. Koehring as president, and is succeeded as treasurer by P. Graser.

Allan W. Dow, formerly of A. W. Dow, Inc., has been appointed consulting technologist of the Asphalt Institute, New York.